Chapter 2 SPCC Rule Applicability

2.1 Introduction

The SPCC rule establishes requirements to prepare and implement SPCC Plans. SPCC Plans complement existing laws, regulations, rules, standards, policies, and procedures pertaining to safety, fire prevention, and oil pollution prevention. The purpose of an SPCC Plan is to form a comprehensive oil spill prevention program that minimizes the potential for discharges. The SPCC Plan must address all relevant spill prevention, control, and countermeasures necessary at the specific facility.

The rule applies to the owners and operators of non-transportation-related onshore and offshore facilities that could reasonably be expected to discharge oil into navigable waters of the United States or adjoining shorelines in quantities that may be harmful. This chapter clarifies which facilities, activities, and equipment are subject to the SPCC rule. The facility owner/operator is responsible for determining whether the facility is subject to the SPCC rule, however, this determination is subject to review by the Regional Administrator or his delegated representative.

§112.1(b)

...this part applies to any owner or operator of a non-transportation-related onshore or offshore facility engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, using, or consuming oil and oil products, which due to its location, could reasonably be expected to discharge oil in quantities that may be harmful, as described in part 110 of this chapter, into or upon the navigable waters of the United States or adjoining shorelines...

Note: The above text is an excerpt of the SPCC rule. Refer to 40 CFR part 112 for the full text of the rule.

2.1.1 Summary of General Applicability

Section 112.1 establishes the general applicability of the SPCC rule. The SPCC rule applies to facilities that:

- Are non-transportation-related;
- Have an aboveground oil storage capacity of more than 1,320 U.S. gallons or a completely buried oil storage capacity greater than 42,000 U.S; and
- Could reasonably be expected to discharge oil to navigable waters or adjoining shorelines in quantities that may be harmful.

Facilities that are owned and operated by federal, state, local government or tribal entities are equally subject to the regulation[20] as any other facility (although the federal government is not subject to civil penalties). Unlike some other federal environmental programs, the Clean Water Act does not authorize EPA to delegate the SPCC program implementation or enforcement to State, local, or tribal representatives.

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20 The SPCC rule requires an owner or operator to develop an SPCC Plan. Under the CWA the definition of owner or operator includes "person" which includes federal, state and local government or tribal entities (33 USC 1362(4) (CWA Section 502(4))).

- ***Section 2.5*** discusses the difference between "transportation-related" and "non-transportation-related" facilities in determining jurisdiction of regulatory agencies.
- ***Section 2.6*** discusses the criteria for a facility to have a "reasonable expectation of a discharge to navigable waters in quantities that may be harmful."
- ***Section 2.7*** addresses storage capacity thresholds and methods of calculating storage capacity.
- ***Section 2.8*** addresses the exemptions to the SPCC rule.
- ***Section 2.9*** discusses the process for a Regional Administrator to determine applicability, outside of the exemptions listed in §112.1(d).
- ***Section 2.10*** addresses the applicability of the rule requirements to different kinds of containers.
- ***Section 2.11*** discusses the applicability of Facility Response Plan (FRP) requirements.
- ***Section 2.12*** describes the role of the EPA inspector.

2.2 Definition of Oil

The SPCC rule applies to the owners and operators of facilities with the potential to discharge oil in quantities that may be harmful to navigable waters or adjoining shorelines. The SPCC rule's definition of oil derives from §311(a)(1) of the Clean Water Act (CWA) which defines oil as *"oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil."*

§112.2

Oil means oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil.

Note: The above text is an excerpt of the SPCC rule. Refer to 40 CFR part 112 for the full text of the rule.

OPA §1001 defined oil separately to exclude any substance which is specifically listed or designated as a hazardous substance under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and which is subject to provisions of that Act.[21] Although oil is defined separately under OPA, that definition did not amend the original CWA definition of oil in §311(a)(1) and therefore was not incorporated into the definition of oil under 40 CFR part 112.2 that applies to both SPCC and FRP regulatory requirements.

[21] Under OPA, "oil" means "oil of any kind or in any form, including petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil, but does not include any substance which is specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601) and which is subject to the provisions of that Act."

In response to Edible Oil Regulatory Reform Act (EORRA) of 1995 (33 U.S.C. 2720) requirements, the oil definition under §112.2 was revised to include the categories of oil in EORRA. Those categories are: (1) petroleum oils, (2) animal fats and vegetable oils; and, (3) other non-petroleum oils and greases.[22]

Section 112.2 of the SPCC rule defines oil as "oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil."

The U.S. Coast Guard (USCG) maintains a separate list of substances it considers oil for its regulatory purposes. The list is available on the USCG Web site and may be used as a guide when determining if a particular substance is an oil.[23] However, it is important to note that for purposes of EPA's regulations, the USCG list is not comprehensive and does not include all oils that are subject to 40 CFR part 112. The sections below discuss whether or not specific substances are considered oils for purposes of SPCC regulation.

2.2.1 Petroleum Oils and Non-Petroleum Oils

The SPCC rule applies to both petroleum oils and non-petroleum oils. Petroleum oils include, but are not limited to, crude and refined petroleum products, asphalt, gasoline, fuel oils, mineral oils, naphtha, sludge, oil refuse, and oil mixed with wastes other than dredged spoil. Nonpetroleum oils and greases include coal tar, creosote, silicon fluids, pine oil, turpentine, and tall oils. (67 FR 47075, July 17, 2002).

Subpart B of 40 CFR part 112 covers both "petroleum oils and non-petroleum oils..." Petroleum oils and non-petroleum oils, including synthetic oils, share common physical properties and produce similar environmental effects. Petroleum and non-petroleum oils can enter all parts of an aquatic system and adjacent shoreline, and similar methods of containment, removal and cleanup are used to reduce the harm created by spills of both types of oils.

2.2.2 Synthetic Oils

Synthetic oils are used in a wide range of applications, including as heat transfer fluids, engine fluids, hydraulic and transmission fluids, metalworking fluids, dielectric fluids, compressor lubricants, and turbine lubricants. Synthetic oils are created by chemical synthesis rather than by refining petroleum crude or extracting oil from plant seeds. Oils that are derived from plant material may be considered animal fats and vegetable oils under subpart C of 40 CFR part 112.

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22 EPA provided notice in 1975 that affirmed that animal fats and vegetable oils (AFVOs) were subject to the SPCC rule (40 FR 28849, July 9, 1975). For more information see *Chapter 1: Introduction*.

23 See the "List of Petroleum and Non-Petroleum Oils" on the USCG Web site at http://www.uscg.mil/vrp/faq/oil.shtml under "Additional References."

2.2.3 Animal Fats and Vegetable Oils (AFVO)

Animal fats and vegetable oils are covered under the SPCC regulation. Animal fats include but are not limited to fats, oils, and greases of animal origin (for example, lard and tallow), fish (for example, cod liver oil), or marine mammal origin (for example, whale oil).

Vegetable oils include but are not limited to oils of vegetable origin, including oils from seeds, nuts, fruits, and kernels. Examples of vegetable oils include: corn oil, rapeseed oil, coconut oil, palm oil, soy bean oil, sunflower seed oil, cottonseed oil, and peanut oil. (67 FR 47075, July 17, 2002).

§112.2

Animal fat means a non-petroleum oil, fat, or grease of animal, fish, or marine mammal origin.

Vegetable oil means a non-petroleum oil or fat of vegetable origin, including but not limited to oils and fats derived from plant seeds, nuts, fruits, and kernels.

Note: The above text is an excerpt of the SPCC rule. Refer to 40 CFR part 112 for the full text of the rule.

2.2.4 Asphalt

Asphalt is a thermoplastic material, composed of unsaturated aliphatic and aromatic compounds, that softens when heated and hardens upon cooling. Within a certain temperature range, it exhibits viscoelastic properties with viscous flow behavior and elastic deformation. All types of asphalt are petroleum oil products, and its composition depends on the source of the crude oil and the process used to manufacture it.

The SPCC rule applies to asphalt cement (AC), as well as to asphalt derivatives such as cutbacks and emulsions. Because of the operational conditions under which AC, cutbacks and emulsions are used and stored, they do pose a risk of being discharged into navigable waters or adjoining shorelines. Although AC) is semi-solid or solid at ambient temperature and pressure, it is generally stored at elevated temperatures. Hot AC is liquid—similar to other semi-solid oils, such as paraffin wax and heavy bunker fuels—and therefore is capable of flowing. Cutbacks and emulsions are liquid at ambient temperature, and because of their low viscosity, they may flow when discharged onto the ground. All of these oils are regulated under the SPCC rule to prevent discharges to navigable waters or adjoining shorelines.

However, hot-mix asphalt (HMA) and HMA containers are exempt from the SPCC rule. HMA is a blend of AC and aggregate material, such as stone, ground tires, sand, or gravel, which is formed into final paving products for use on roads and parking lots. HMA is unlikely to flow as a result of the entrained aggregate, such that there would be very few circumstances, if any, in which a discharge of HMA would have the potential to reach navigable waters or adjoining shorelines.

2.2.5 Natural Gas and Condensate

The SPCC rule does not apply to natural gas (including liquid natural gas and liquid petroleum gas). EPA does not consider highly volatile liquids that volatilize on contact with air or water, such as liquid natural gas or liquid petroleum gas, to be oil (67 FR 47076, July 17, 2002). Furthermore, EPA has stated that hydrocarbons in a

gaseous phase under ambient pressure and temperature, such as natural gas, present at SPCC regulated facilities are not regulated under the SPCC rule (73 FR 74271, December 5, 2008).

However, natural gas liquid condensate (often referred to as "natural gasoline" or "drip gas") is an oil subject to the SPCC rule. Condensate can accumulate in tanks, containers, or other equipment. For the purposes of determining SPCC applicability, containers with 55 gallons or more in capacity storing condensate must be included in a natural gas facility's total oil storage capacity calculation.

More information on specific types of facilities handling both natural gas and oil and how they are regulated under the SPCC rule can be found in *Section 2.4.7*.

2.2.6 Oil and Water Mixtures

Oil and water mixture containers are subject to the SPCC rule. A mixture of wastewater and oil is "oil" under the statutory and regulatory definition of the term (33 U.S.C. 1321(a)(1) and 40 CFR 110.2 and 112.2). A discharge of wastewater containing oil to navigable waters or adjoining shorelines in a "harmful quantity" (40 CFR part 110) is prohibited (see July 17, 2002, 67 FR 47069). One example of an oil and water mixture is produced water.

2.2.7 Produced Water

The SPCC rule applies to produced water from an oil well. Produced water is the oil and water mixture resulting from the separation of crude oil or gas from the fluids or gases extracted from the oil/gas reservoir, prior to disposal, subsequent use (e.g., re-injection or beneficial reuse), or further treatment. Produced water's chemical and physical characteristics vary considerably depending on the geologic formation, usually being commingled with oil and gas at the wellhead, and changing in composition as the oil or natural gas fraction is separated and sent to market.

§112.2

Produced water container means a storage container at an oil production facility used to store the produced water after initial oil/water separation, and prior to reinjection, beneficial reuse, discharge, or transfer for disposal.

Note: The above text is an excerpt of the SPCC rule. Refer to 40 CFR part 112 for the full text of the rule.

Produced water is typically collected in produced water containers at the end of the oil and gas treatment process, and often accumulates emulsified oil not captured in the separation process. Under normal operating conditions, a layer of oil may be present on top of the fluids. The amount of oil by volume observed in produced water storage containers varies, but based on EPA's assessment, is generally estimated to range from less than one to ten percent by volume, and can be greater. Oil may be present not only in free phase, but also in other forms, such as in a dissolved phase, emulsion or a sludge at the bottom of the produced water container.

Oil discharges to navigable waters or adjoining shorelines from an oil/water mixture in a produced water container may cause harm. Such mixtures[24] are regulated as oil under the SPCC rule. Therefore, the capacity of

[24] Refers to mixtures in the produced water container.

produced water containers counts toward the facility aggregate oil storage capacity. Produced water containers at oil production, oil recycling or oil recovery facilities are not eligible for the wastewater treatment exemption in §112.1(d)(6).

2.2.8 Hazardous Substances and Hazardous Waste

The definition of "oil" in §112.2 includes but is not limited to "oil mixed with wastes other than dredged spoil." Oils covered under the SPCC rule include certain hazardous substances or hazardous wastes that are oils, as well as certain hazardous substances or hazardous wastes that are mixed with oils. Containers storing these substances may also be covered by other regulations, such as the Resource Conservation and Recovery Act (RCRA) or CERCLA (also known as Superfund). For example, the definition of oil under §112.2 includes "used oil" because it is an oil mixed with wastes. "Used oil," as defined in EPA's *Standards for the Management of Used Oil* at 40 CFR 279.1, means any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities.

Inspectors should evaluate whether containers storing hazardous substances or mixtures of wastes contain oil. Hazardous substances or hazardous wastes that are neither oils nor mixed with oils are not subject to SPCC rule requirements. For purposes of 40 CFR part 112, the CWA §311(b)(2) hazardous substances as identified under 40 CFR part 116 are not considered oils. However, an oil mixture that includes a CWA hazardous substance is subject to 40 CFR part 112 when it meets the definition of oil in the regulation. For example, benzene is a CWA hazardous substance and therefore does not meet the definition of oil in §112.2; however, benzene is a constituent of gasoline which is a mixture that includes other oils. Gasoline is an oil as defined under 40 CFR part 112.2.

Although the rule contains an exemption for completely buried tanks that are subject to all underground storage tank (UST) technical requirements of 40 CFR part 280 and/or a state program approved under part 281 under §112.1(d)(2)(i) or (4), tanks containing RCRA hazardous wastes are not subject to the UST rules. Therefore, when RCRA hazardous wastes tanks located at a facility subject to the SPCC rule also contain oil, they are subject to the SPCC rule requirements.

2.2.9 Denatured Ethanol used in Renewable Fuels

Renewable fuels, such as E85 or "flex fuel" (15% unleaded gasoline and 85% ethanol) are produced in a blending process.[25] Ethanol used for fuel often contains a denaturing additive (typically gasoline, natural gasoline, diesel fuel or other oil petroleum product) which is oil. Therefore, the final denatured ethanol is also considered an oil, and facilities handling or storing denatured ethanol may be subject to the SPCC requirements. An EPA letter dated November 7, 2006 details the Agency's position on denatured ethanol (see *Appendix H*).

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[25] For more information on ethanol renewable fuels see: http://epa.gov/region07/priorities/agriculture/pdf/ethanol_plants_manual.pdf

2.2.10 Biodiesel and Biodiesel Blends

Biodiesel and biodiesel blends are other types of renewable fuels that are often stored and handled at facilities regulated under 40 CFR part 112.[26] Biodiesel, designated B100, is a domestic, renewable fuel for diesel engines derived from natural oils like soybean oil. Biodiesel is comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats.

Biodiesel can be used in any concentration with petroleum-based diesel fuel in existing diesel engines with little or no modification. Biodiesel is not the same as raw vegetable oil. It is produced by a chemical process which removes the glycerin from the oil. Biodiesel is typically produced by a reaction of a vegetable oil or animal fat with an alcohol such as methanol or ethanol in the presence of a catalyst to yield mono-alkyl esters and glycerin, which is removed.

Biodiesel blends are a blend of biodiesel fuel with petroleum-based diesel fuel, designated BXX, where XX represents the volume percentage of biodiesel fuel in the blend. Both biodiesel (B100) and biodiesel blends are considered oil for the purposes of 40 CFR part 112.

2.3 Activities Involving Oil

Section 112.1(b) specifies the following oil-related activities are regulated under the SPCC rule: "drilling, producing, gathering, storing, processing, refining, transferring, distributing, using, or consuming oil and oil products." These activities are subject to SPCC provided the facility meets the other applicability criteria in §112.1. *Table 2-1* provides examples of these activities.

§112.1(b)

...this part applies to any owner or operator of a non-transportation-related onshore or offshore facility engaged in ***drilling, producing, gathering, storing, processing, refining, transferring, distributing, using, or consuming*** oil and oil products....

Note: The above text is an excerpt of the SPCC rule. Refer to 40 CFR part 112 for the full text of the rule. ***Emphasis added***.

[26] For more information on biodiesel renewable fuels see: http://epa.gov/region07/priorities/agriculture/pdf/biodiesel_manual.pdf

USEPA SPCC Guidance Document

The SPCC rule applies to facilities with the potential to discharge "oil" in quantities that may be harmful to navigable waters and adjoining shorelines. The SPCC rule's definition of oil originated from the Clean Water Act (CWA). Section 311(a)(1) of the CWA defines oil as "oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil." Petroleum oils include crude and refined petroleum products, asphalt, gasoline, fuel oils, mineral oils, naphtha, sludge, oil refuse, and oil mixed with wastes other than dredged spoil (67 FR 47075).

§112.2
Oil means oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil.

Note: The above text is an excerpt of the SPCC rule. Refer to 40 CFR part 112 for the full text of the rule.

The U.S. Coast Guard (USCG) compiled a list of substances it considers oil (see below), based on the CWA definition. The list is available on the USCG Web site[1] Note, however, that the USCG list is not comprehensive and does not define "oil" for purposes of 40 CFR part 112. EPA may determine that a substance, chemical, material, or mixture is an oil even if it is not on the USCG list. For more information see EPA's Guidance (http://www.epa.gov/emergencies/docs/oil/spcc/guidance/2_Applicability.pdf)

USCG List Of Petroleum and Non-petroleum Oils

This USGC list of oils is organized alphabetically into several subgroups. This list in not a complete list of oils regulated under 40 CFR part 112, rather a list of chemicals that are considered oil by the U.S. Coast Guard. Crude oil and refined petroleum products are among the most familiar types of oils. Petroleum and fuel oil are specifically named in the Clean Water Act (CWA) definition of oil. Edible animal and vegetable oils and other oils of animal or vegetable origin have historically been considered CWA oils. Other non-petroleum oils are substances that have the properties and behavior of traditional oils and have historically been considered to be oils. Lube-oil additives are included in the list of oils because they may be shipped or stored in an oil medium. Some substances that have not been considered oils historically may be added to this list in the future if they are determined to have oil-like characteristics. If you have a question about whether a commodity that does not appear on this list is regulated as an oil, please call **Mr. Tom Felleisen, G-MSO-3, of the U.S. Coast Guard at 202-267-0086**.

[1] See the "List of Petroleum and Non-Petroleum Oils" on the USCG Web site at https://homeport.uscg.mil/mycg/portal/ep/contentView.do?contentTypeId=2&channelId=-30565&contentId=120944&programId=117833&programPage=%2Fep%2Fprogram%2Feditorial.jsp&pageTypeId=13489&BV_SessionID=@@@@1350455393.1250257064@@@@&BV_EngineID=cccdadehmkjifjkcfjgcfgfdffhdghm.0

Crude Oil and Refined Petroleum Products

Alkanes (C6-C9)
n-Alkanes (C10+)
iso- & cyclo-Alkanes (C10-C11)
Alkylbenzenes (C9+)
Alkylbenzene, Alkylindane, Alkylindene mixture (each C12-C17)
Asphalt
Asphalt: cutback
Asphalt: emulsion
Asphalt blending stocks: Roofers flux
Asphalt blending stocks: Straight run residue
Aviation alkylates
Cobalt naphthenate in Solvent naphtha
p-Cymene
Diisopropyl naphthalene
Distillates: Flashed feed stocks
Distillates: Straight run
Ethyl cyclohexane
Gas oil: Cracked
Gasoline: Automotive (not over 4.23g Pb/gal)
Gasoline: Aviation (not over 4.86g Pb/gal)
Gasoline: Casinghead (natural)
Gasoline: Polymer
Gasoline: Straight run
Gasoline blending stocks: Alkylates
Gasoline blending stocks: Reformates
Heptane (all isomers)
Heptene (all isomers)
Hexane (all isomers)
Hexene (all isomers)
Jet fuel: Jet A-1
Jet fuel: Jet A
Jet fuel: Jet B
Jet fuel: JP-4
Jet fuel: JP-5 (Kerosene, heavy)
Jet fuel: JP-8
Kerosene
Methylcyclohexane
Mineral spirits
Naphtha: Heavy
Naphtha: Paraffinic
Naphtha: Petroleum
Naphtha: Solvent
Naphtha: Stoddard solvent
Naphtha: VM & P (75% Naphtha)
Nonane (all isomers)
Nonylbenzene
Octane (all isomers)
Oil, fuel: No. 1
Oil, fuel: No. 1-D
Oil, fuel: No. 2
Oil, fuel: No. 2-D
Oil, fuel: No. 4
Oil, fuel: No. 5
Oil, fuel: No. 6
Oil, misc: Aliphatic
Oil, misc: Aromatic
Oil, misc: Clarified
Oil, misc: Coal
Oil, misc: Crude
Oil, misc: Diesel
Oil, misc: Gas, low pour
Oil, misc: Gas, low sulfur
Oil, misc: Heartcut distillate
Oil, misc: Lubricating
Oil, misc: Mineral
Oil, misc: Mineral seal
Oil, misc: Motor
Oil, misc: Penetrating
Oil, misc: Residual
Oil, misc: Road
Oil, misc: Seal
Oil, misc: Spindle
Oil, misc: Transformer
Oil, misc: Turbine
Olefin mixtures (C5-C7)
alpha-Olefins (C6-C18) mixtures
Olefins (C13+)
Pentene (all isomers)
1-Phenyl-1-xylyl ethane
iso-Propylcyclohexane
Tetrahydronaphthalene
White spirit (low (15-20%) aromatic)

Edible Animal and Vegetable Oils

Oil, edible: Beechnut
Oil, edible: Castor
Oil, edible: Cocoa butter
Oil, edible: Coconut
Oil, edible: Cod liver
Oil, edible: Corn (maize)
Oil, edible: Cottonseed
Oil, edible: Fish
Oil, edible: Groundnut
Oil, edible: Hazelnut
Oil, edible: Lard
Oil, edible: Nutmeg butter
Oil, edible: Olive
Oil, edible: Palm
Oil, edible: Palm kernel
Oil, edible: Peanut
Oil, edible: Peel
Oil, edible: Poppy
Oil, edible: Poppy seed
Oil, edible: Raisin seed
Oil, edible: Rapeseed
Oil, edible: Rice bran
Oil, edible: Safflower
Oil, edible: Salad
Oil, edible: Sesame
Oil, edible: Soya bean
Oil, edible: Sunflower seed
Oil, edible: Tucum
Oil, edible: Vegetable
Oil, edible: Walnut

Other Oils of Animal or Vegetable Origin

Animal and Fish oils, n. o. s.
Animal and fish acids oils and distillates, n. o. s.
Camphor oil
Cashew nut shell oil (untreated)
Creosote (wood)
Fatty acid (saturated, C13+)
Fatty acid amides
Oil, misc: Animal
Oil, misc: Coconut, fatty acid methyl ester
Oil, misc: Coconut oil, fatty acid
Oil, misc: Cottonseed oil, fatty acid
Oil, misc: Lanolin
Oil, misc: Linseed
Oil, misc: Neatsfoot
Oil, misc: Oiticica
Oil, misc: Palm oil, fatty acid methyl ester
Oil, misc: Perilla
Oil, misc: Pilchard
Oil, misc: Pine
Oil, misc: Rosin
Oil, misc: Soapstock
Oil, misc: Soybean (epoxidized)
Oil, misc: Sperm
Oil, misc: Tall
Oil, misc: Tall, fatty acid
Oil, misc: Tallow
Oil, misc: Tung
Oil, misc: Whale
Palm kernel acid oil
Palm kernel acid oil, methyl ester
Palm Olein
Palm Stearin
Palm Fatty Acid Distillate
Tallow fatty acid
Tallow nitrile
Turpentine
Vegetable acid oils and distillates, n. o. s.
Vegetable oils, n. o. s.

Other Non-Petroleum Oils

Anthracene oil (Coal tar fraction)
Coal tar
Coal tar pitch (molten)
Creosote (Coal tar)
Naphtha: Coal tar solvent
Polydimethylsiloxane

Lube-Oil Additives

Alkaryl polyether (C9-C20)
Alkenyl (C11+) amide
Alkyl (C8+) amine, alkenyl (C12+) acid ester mixture
Alkyl (C11-C17) benzene sulfonic acid
Alkylbenzene sulfonic acid, sodium salt solution
Alkyl dithiothiadiazole (C6-C24)
Alkyl (C8-C40) phenol sulfide
Alkyl (C8-C9) phenylamine in aromatic solvents
Alkyl (C10-C20), saturated and unsaturated) phosphite
Aryl polyolefin (C11-C50)
Calcium alkyl (C9) phenol sulfide, polyolefin phosphorosulfide mixture
Calcium long chain alkaryl sulfonate (C11-C50)
Calcium long chain alkyl (C5-C10) phenate
Calcium long chain alkyl (C11-C40) phenate
Calcium long chain alkyl phenate sulfide (C8-C40)
Calcium long chain alkyl salicylate (C13+)
Calcium long chain alkyl phenolic amine (C8-C40)
Chlorinated paraffins (C18+) with any level of chlorine
Dialkyl (C8-C9) diphenylamines
Dibutyl hydrogen phosphonate
Diphenylamine, reaction product with 2, 2, 4-Trimethylpentene
Diphenylamines, alkylated
Dodecyl hydroxypropyl sulfide
Glycerol monooleate
Long chain alkaryl polyether (C11-C20)
Long chain alkaryl sulfonic acid (C16-C60)
Long chain alkylphenate/Phenol sulfide mixture
Magnesium long chain alkaryl sulfonate (C11-C50)
Magnesium long chain alkyl salicylate (C11+)
Olefin/Alkyl ester copolymer (molecular weight 2000+)
Oleylamine
Phosphate esters, alkyl (C12-C14) amine
Polyalkyl (C10-C20) methacrylate
Polyether (molecular weight 2000+)
Polyether, borated
Polyisobutenyl anhydride adduct
Polyolefin (molecular weight 300+)
Polyolefin amide alkeneamine (C28+)
Polyolefin amide alkeneamine borate (C28-C250)
Polyolefin amide alkeneamine molybdenum oxysulfide mixture
Polyolefin amide alkeneamine polyol
Polyolefinamine (C28-C250)
Polyolefinamine in alkyl (C2-C4) benzenes
Polyolefin aminoester salt
Polyolefin anydride
Polyolefin ester (C28-C250)
Polyolefin phenolic amine (C28-C250)
Polyolefin phosphorosulfide – Barium derivative (C28-C250)
Sodium petroleum sulfonate
Sulfohydrocarbon (C3-C88)
Sulfohydrocarbon, long chain (C18+_ alkylamine mixture
Sulfurized fat (C14-C20)
Sulfurized polyolefinamide alkene (C28-C250) amine
Tall oil fatty acid, barium salts
Zinc alkaryl dithiophosphate (C7-C16)
Zinc alkyl dithiophosphate (C3-C14)

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engine on a public vessel) and any discharges of such oil accumulated in the bilges of a vessel discharged in compliance with MARPOL 73/78, Annex I, as provided in 33 CFR part 151, subpart A;

(b) Other discharges of oil permitted under MARPOL 73/78, Annex I, as provided in 33 CFR part 151, subpart A; and

(c) Any discharge of oil explicitly permitted by the Administrator in connection with research, demonstration projects, or studies relating to the prevention, control, or abatement of oil pollution.

[61 FR 7421, Feb. 28, 1996]

§ 110.6 Notice.

Any person in charge of a vessel or of an onshore or offshore facility shall, as soon as he or she has knowledge of any discharge of oil from such vessel or facility in violation of section 311(b)(3) of the Act, immediately notify the National Response Center (NRC) (800–424–8802; in the Washington, DC metropolitan area, 202–426–2675). If direct reporting to the NRC is not practicable, reports may be made to the Coast Guard or EPA predesignated On-Scene Coordinator (OSC) for the geographic area where the discharge occurs. All such reports shall be promptly relayed to the NRC. If it is not possible to notify the NRC or the predesignated OCS immediately, reports may be made immediately to the nearest Coast Guard unit, provided that the person in charge of the vessel or onshore or offshore facility notifies the NRC as soon as possible. The reports shall be made in accordance with such procedures as the Secretary of Transportation may prescribe. The procedures for such notice are set forth in U.S. Coast Guard regulations, 33 CFR part 153, subpart B and in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR part 300, subpart E.

(Approved by the Office of Management and Budget under control number 2050–0046)

[52 FR 10719, Apr. 2, 1987. Redesignated and amended at 61 FR 7421, Feb. 28, 1996; 61 FR 14032, Mar. 29, 1996]

PART 112—OIL POLLUTION PREVENTION

Sec.

=> SPCC

the United States and is located in, on, or under any other waters.

Oil means oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil.

Oil Spill Removal Organization means an entity that provides oil spill response resources, and includes any for-profit or not-for-profit contractor, cooperative, or in-house response resources that have been established in a geographic area to provide required response resources.

Onshore facility means any facility of any kind located in, on, or under any land within the United States, other than submerged lands.

Owner or operator means any person owning or operating an onshore facility or an offshore facility, and in the case of any abandoned offshore facility, the person who owned or operated or maintained the facility immediately prior to such abandonment.

Partially buried tank means a storage container that is partially inserted or constructed in the ground, but not entirely below grade, and not completely covered with earth, sand, gravel, asphalt, or other material. A partially buried tank is considered an aboveground storage container for purposes of this part.

Permanently closed means any container or facility for which:

(1) All liquid and sludge has been removed from each container and connecting line; and

(2) All connecting lines and piping have been disconnected from the container and blanked off, all valves (except for ventilation valves) have been closed and locked, and conspicuous signs have been posted on each container stating that it is a permanently closed container and noting the date of closure.

Person includes an individual, firm, corporation, association, or partnership.

Petroleum oil means petroleum in any form, including but not limited to crude oil, fuel oil, mineral oil, sludge, oil refuse, and refined products.

Production facility means all structures (including but not limited to wells, platforms, or storage facilities), piping (including but not limited to flowlines or gathering lines), or equipment (including but not limited to workover equipment, separation equipment, or auxiliary non-transportation-related equipment) used in the production, extraction, recovery, lifting, stabilization, separation or treating of oil, or associated storage or measurement, and located in a single geographical oil or gas field operated by a single operator.

Regional Administrator means the Regional Administrator of the Environmental Protection Agency, in and for the Region in which the facility is located.

Repair means any work necessary to maintain or restore a container to a condition suitable for safe operation, other than that necessary for ordinary, day-to-day maintenance to maintain the functional integrity of the container and that does not weaken the container.

Spill Prevention, Control, and Countermeasure Plan; SPCC Plan, or Plan means the document required by § 112.3 that details the equipment, workforce, procedures, and steps to prevent, control, and provide adequate countermeasures to a discharge.

Storage capacity of a container means the shell capacity of the container.

Transportation-related and non-transportation-related, as applied to an onshore or offshore facility, are defined in the Memorandum of Understanding between the Secretary of Transportation and the Administrator of the Environmental Protection Agency, dated November 24, 1971, (Appendix A of this part).

United States means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, Guam, American Samoa, the U.S. Virgin Islands, and the Pacific Island Governments.

Vegetable oil means a non-petroleum oil or fat of vegetable origin, including but not limited to oils and fats derived

List of Petroleum and Non-petroleum Oils

This list of oils is organized alphabetically into several subgroups. Crude oil and refined petroleum products are among the most familiar types of oils. Petroleum and fuel oil are specifically named in the Clean Water Act (CWA) definition of oil. Edible animal and vegetable oils and other oils of animal or vegetable origin have historically been considered CWA oils. Other non-petroleum oils are substances that have the properties and behavior of traditional oils and have historically been considered to be oils. Lube-oil additives are included in the list of oils because they may be shipped or stored in an oil medium. Some substances that have not been considered oils historically may be added to this list in the future if they are determined to have oil-like characteristics. If you have a question about whether a commodity that does not appear on this list is regulated as an oil, please call (b) (7)(C) **CG-5223, at +1 202 372 1424.**

Crude Oil and Refined Petroleum Products

- Alkanes (C6-C9)
- n-Alkanes (C10+)
- iso- & cyclo-Alkanes (C10-C11)
- Alkylbenzenes (C9+)
- Alkylbenzene, Alkylindane, Alkylindene mixture (each C12-C17)
- Asphalt
- Asphalt: cutback
- Asphalt: emulsion
- Asphalt blending stocks: Roofers flux
- Asphalt blending stocks: Straight run residue
- Aviation alkylates
- Cobalt naphthenate in Solvent naphtha
- p-Cymene
- Diisopropyl naphthalene
- Distillates: Flashed feed stocks
- Distillates: Straight run
- Ethyl cyclohexane
- Gas oil: Cracked
- Gasoline: Automotive (not over 4.23g Pb/gal)
- Gasoline: Aviation (not over 4.86g Pb/gal)
- Gasoline: Casinghead (natural)
- Gasoline: Polymer
- Gasoline: Straight run
- Gasoline blending stocks: Alkylates
- Gasoline blending stocks: Reformates
- Heptane (all isomers)
- Heptene (all isomers)
- Hexane (all isomers)
- Hexene (all isomers)
- Jet fuel: Jet A-1
- Jet fuel: Jet A

- Jet fuel: Jet B
- Jet fuel: JP-4
- Jet fuel: JP-5 (Kerosene, heavy)
- Jet fuel: JP-8
- Kerosene
- Methylcyclohexane
- Mineral spirits
- Naphtha: Heavy
- Naphtha: Paraffinic
- Naphtha: Petroleum
- Naphtha: Solvent
- Naphtha: Stoddard solvent
- Naphtha: VM & P (75% Naphtha)
- Nonane (all isomers)
- Nonylbenzene
- Octane (all isomers)
- Oil, fuel: No. 1
- Oil, fuel: No. 1-D
- Oil, fuel: No. 2
- Oil, fuel: No. 2-D
- Oil, fuel: No. 4
- Oil, fuel: No. 5
- Oil, fuel: No. 6
- Oil, misc: Aliphatic
- Oil, misc: Aromatic
- Oil, misc: Clarified
- Oil, misc: Coal
- Oil, misc: Crude
- Oil, misc: Diesel
- Oil, misc: Gas, low pour
- Oil, misc: Gas, low sulfur
- Oil, misc: Heartcut distillate
- Oil, misc: Lubricating
- Oil, misc: Mineral
- Oil, misc: Mineral seal
- Oil, misc: Motor
- Oil, misc: Penetrating
- Oil, misc: Residual
- Oil, misc: Road
- Oil, misc: Seal
- Oil, misc: Spindle
- Oil, misc: Transformer
- Oil, misc: Turbine
- Olefin mixtures (C5-C7)
- alpha-Olefins (C6-C18) mixtures
- Olefins (C13+)

- Pentene (all isomers)
- 1-Phenyl-1-xylyl ethane
- iso-Propylcyclohexane
- Tetrahydronaphthalene
- White spirit (low (15-20%) aromatic)

Edible Animal and Vegetable Oils

- Oil, edible: Beechnut
- Oil, edible: Castor
- Oil, edible: Cocoa butter
- Oil, edible: Coconut
- Oil, edible: Cod liver
- Oil, edible: Corn (maize)
- Oil, edible: Cottonseed
- Oil, edible: Fish
- Oil, edible: Groundnut
- Oil, edible: Hazelnut
- Oil, edible: Lard
- Oil, edible: Nutmeg butter
- Oil, edible: Olive
- Oil, edible: Palm
- Oil, edible: Palm kernel
- Oil, edible: Peanut
- Oil, edible: Peel
- Oil, edible: Poppy
- Oil, edible: Poppy seed
- Oil, edible: Raisin seed
- Oil, edible: Rapeseed
- Oil, edible: Rice bran
- Oil, edible: Safflower
- Oil, edible: Salad
- Oil, edible: Sesame
- Oil, edible: Soya bean
- Oil, edible: Sunflower seed
- Oil, edible: Tucum
- Oil, edible: Vegetable
- Oil, edible: Walnut

Other Oils of Animal or Vegetable Origin

- Animal and Fish oils, n. o. s.
- Animal and fish acids oils and distillates, n. o. s.
- Camphor oil
- Cashew nut shell oil (untreated)
- Creosote (wood)

- Fatty acid (saturated, C13+)
- Fatty acid amides
- Oil, misc: Animal
- Oil, misc: Coconut, fatty acid methyl ester
- Oil, misc: Coconut oil, fatty acid
- Oil, misc: Cottonseed oil, fatty acid
- Oil, misc: Lanolin
- Oil, misc: Linseed
- Oil, misc: Neatsfoot
- Oil, misc: Oiticica
- Oil, misc: Palm oil, fatty acid methyl ester
- Oil, misc: Perilla
- Oil, misc: Pilchard
- Oil, misc: Pine
- Oil, misc: Rosin
- Oil, misc: Soapstock
- Oil, misc: Soybean (epoxidized)
- Oil, misc: Sperm
- Oil, misc: Tall
- Oil, misc: Tall, fatty acid
- Oil, misc: Tallow
- Oil, misc: Tung
- Oil, misc: Whale
- Palm kernel acid oil
- Palm kernel acid oil, methyl ester
- Palm Olein
- Palm Stearin
- Palm Fatty Acid Distillate
- Tallow fatty acid
- Tallow nitrile
- Turpentine
- Vegetable acid oils and distillates, n. o. s.
- Vegetable oils, n. o. s.

Other Non-Petroleum Oils

- Anthracene oil (Coal tar fraction)
- Coal tar
- Coal tar pitch (molten)
- Creosote (Coal tar)
- Naphtha: Coal tar solvent
- Polydimethylsiloxane

Lube-Oil Additives

- Alkaryl polyether (C9-C20)

- Alkenyl (C11+) amide
- Alkyl (C8+) amine, alkenyl (C12+) acid ester mixture
- Alkyl (C11-C17) benzene sulfonic acid
- Alkylbenzene sulfonic acid, sodium salt solution
- Alkyl dithiothiadiazole (C6-C24)
- Alkyl (C8-C40) phenol sulfide
- Alkyl (C8-C9) phenylamine in aromatic solvents
- Alkyl (C10-C20), saturated and unsaturated) phosphite
- Aryl polyolefin (C11-C50)
- Calcium alkyl (C9) phenol sulfide, polyolefin phosphorosulfide mixture
- Calcium long chain alkaryl sulfonate (C11-C50)
- Calcium long chain alkyl (C5-C10) phenate
- Calcium long chain alkyl (C11-C40) phenate
- Calcium long chain alkyl phenate sulfide (C8-C40)
- Calcium long chain alkyl salicylate (C13+)
- Calcium long chain alkyl phenolic amine (C8-C40)
- Chlorinated paraffins (C18+) with any level of chlorine
- Dialkyl (C8-C9) diphenylamines
- Dibutyl hydrogen phosphonate
- Diphenylamine, reaction product with 2, 2, 4-Trimethylpentene
- Diphenylamines, alkylated
- Dodecyl hydroxypropyl sulfide
- Glycerol monooleate
- Long chain alkaryl polyether (C11-C20)
- Long chain alkaryl sulfonic acid (C16-C60)
- Long chain alkylphenate/Phenol sulfide mixture
- Magnesium long chain alkaryl sulfonate (C11-C50)
- Magnesium long chain alkyl salicylate (C11+)
- Olefin/Alkyl ester copolymer (molecular weight 2000+)
- Oleylamine
- Phosphate esters, alkyl (C12-C14) amine
- Polyalkyl (C10-C20) methacrylate
- Polyether (molecular weight 2000+)
- Polyether, borated
- Polyisobutenyl anhydride adduct
- Polyolefin (molecular weight 300+)
- Polyolefin amide alkeneamine (C28+)
- Polyolefin amide alkeneamine borate (C28-C250)
- Polyolefin amide alkeneamine molybdenum oxysulfide mixture
- Polyolefin amide alkeneamine polyol
- Polyolefinamine (C28-C250)
- Polyolefinamine in alkyl (C2-C4) benzenes
- Polyolefin aminoester salt
- Polyolefin anydride
- Polyolefin ester (C28-C250)
- Polyolefin phenolic amine (C28-C250)

- Polyolefin phosphorosulfide – Barium derivative (C28-C250)
- Sodium petroleum sulfonate
- Sulfohydrocarbon (C3-C88)
- Sulfohydrocarbon, long chain (C18+_ alkylamine mixture
- Sulfurized fat (C14-C20)
- Sulfurized polyolefinamide alkene (C28-C250) amine
- Tall oil fatty acid, barium salts
- Zinc alkaryl dithiophosphate (C7-C16)
- Zinc alkyl dithiophosphate (C3-C14)

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Studies on the Fatty Acid Composition of Edible Oil

(b) (7)(C)

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Abstract

Fatty acid analysis of the five types of locally consumed edible oils (n = 22) was carried out using a Gas Chromatograph (G.C) equipped with a Flame Ionization Detector (FID) and stainless steel packed column. The results showed that sunflower oil contained the highest percentage of long chain mono and polyunsaturated fatty acids (91.49 ± 1.91 %) compared to soybean oil (81.14 ± 1.49 %), mustard oil (86.80 ± 3.07 %), palm oil (53.30 ± 0.36 %) and coconut oil (7.12 ± 0.51 %). Two varieties of mustard oil, low erucic (= 5 %, n=3) and high erucic acid (>14 %, n=2) and two varieties of sunflower oil, high linoleic-low oleic (61-66 % & 22-27 %, n=2) and low linoleic- high oleic (29-38 % and 53-63 %, n = 3) were found. Sunflower oil with the highest percentage of mono and polyunsaturated fatty acids especially the high linoleic-low oleic variety appeared to be superior and most suitable edible oil for mass consumption.

Key words: Fatty acid, Gas chomatograph, Sunflower oil, Soybean oil, Mustard oil, Palm oil, Coconut oil.

Introduction

Edible oil is an essential nutrient and an important source of energy providing 9 kcal/g. For oil to be utilized as a source of energy it must be well digested and absorbed into the body (Tannenbaum, 1979). Oils in the diet are available to the body as fatty acids, which are excellent sources of dietary calorie intake. Fatty acids (FAs) are classified as saturated (SFA), monounsaturated (MUFA) and poly-unsaturated (PUFA) fatty acids. The total energy intake from oils for a normal healthy adult is approximately 30 energy percent and that in the western diets is about 40 energy percent. High fat diets enhance the incidence of coronary heart disease (Romon *et al.* 1995 and Simon *et al.* 1995). Risk factors for coronary heart disease (CHD) such as elevated levels of serum total cholesterol, low density lipoprotein cholesterol (LDL-C), serum triglycerides (TG) and reduced levels of high density lipoprotein cholesterol (HDL-C) are modulated by the fat content in the diet. A high intake of saturated fatty acids and cholesterol in the diet

may lead to hypercholesterolaemia, largely through an increase in LDL-C. On the contrary, polyunsaturated fatty acids have a hypocholesterolaemic effect in human (Sundram, K. 2003). Deficiency of essential fatty acids (EFA) such as linoleic (18:2), linolenic (18:3) and arachidonic acid (20:4), growth is retarded and dermal symptoms appear. Patients with chronic intestinal disorders causing malabsorption, nutritional losses through diarrhoea or catabolic illness would be expected to have EFA deficiency (Kaul *et al.* 1986, Okeef, 1996 and Siguel *et. al.*1996).

The aim of this study was to find out a suitable variety of locally available edible oil rich in essential fatty acids for general mass to combat malnutrition.

Materials and Methods

Edible oil samples of five different varieties: sunflower oil (5 samples), soybean oil (3 samples), palm oil (3 samples), mustard oil (5 samples) and coconut oil (6 samples) were collected from local market during the period between July 2002 to June 2003.

Preparation of fatty acid methyl ester (FAME)

Relative concentration of fatty acid (FA) from oil samples were measured as their corresponding methyl esters according to the method described in IUPAC (1979) with a minor modification. 5-7 drops (~50 µl each) of oil was taken in 15 ml test tube and 3 ml of 0.5 M sodium methoxide (prepared by mixing metallic sodium in methanol) was added and digested by stirring in a boiling water bath for about 15 minutes. It was allowed to cool to room temperature and 1 ml of petroleum ether (b.p 40-60^{O} C) was added followed by 10 ml deionized water, mixed gently and allowed to settle for some time. The distinct upper layer of methyl ester in petroleum ether was separated carefully in a capped vial and used for analysis. 200 mg of different fatty acid standards in their respective methyl ester form were dissolved separately in 10 ml petroleum ether (b.p 40-60^{O} C) in a series of screw capped test tubes. Aliquots of 1µL FAME was injected and peaks were recorded for their respective retention time and areas by the data processor unit of the GC.

Chromatography

Analysis of FAME was carried out on Gas Chromatograph (GC) Model-14B, Shimadzu, Japan loaded with software Class GC-10 (version-2.00). The GC was equipped with Flame Ionization Detector (FID) and stainless steel column, dimension 10 X 1/8, packed with 5 % DEGS-PS. The column was conditioned at 180^{O} C about 2 hours for attaining thermal stability before use. The operating condition was programmed at oven temperature 150^{O}C (hold time 5min) with increasing rate 8^{O} C/min to190^{O} C (hold time 0 min), 2^{O} C/min to 200^{O} C (hold time 10min), injection temperature 250^{O} C and

detector temperature 250° C. Nitrogen was used as a carrier gas with flow rate of 20 ml/min.

Results and Discussion

A total of 22 edible oil samples collected from the local markets were analyzed using gas chromatograph for their fatty acid (FA) compositions of them, five samples were of sunflower oil, three of soybean oil, five of mustard oil, three of palm oil and six of coconut oil. Their respective fatty acid (FA) percent composition are shown in Table-I and the mean of total saturated fatty acid (SFA), monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) percent are shown in Table II. Table III shows the varieties of mustard oil and sunflower oil.

Table I. Fatty acid composition of different types of edible oil

Fatty acids %	Sunflower oil (n=5) Mean ± SD	Soybean oil (n=3) Mean ± SD	Mustard oil (n=5) Mean ± SD	Palm oil (n=3) Mean ± SD	Coconut oil (n=6) Mean ± SD
Caprylic ($C_{8:0}$)	--	--	--	--	6.21 ± 0.34
Capric ($C_{10:0}$)	--	--	--	--	6.15 ± 0.21
Lauric ($C_{12:0}$)	--	--	--	--	51.02 ± 0.71
Myristic ($C_{14:0}$)	--	--	--	1.23 ± 0.28	18.94 ± 0.63
Palmitic ($C_{16:0}$)	6.52 ± 1.75	14.04 ± 0.62	4.51 ± 3.83	41.78 ± 1.27	8.62 ± 0.50
Stearic ($C_{18:0}$)	1.98 ± 1.44	4.07 ± 0.29	2.78 ± 0.59	3.39± 0.65	1.94 ± 0.17
Oleic ($C_{18:1}$)	45.39 ± 18.77	23.27 ± 2.43	38.21 ± 21.88	41.90 ± 1.20	5.84 ± 0.50
Linoleic ($C_{18:2}$)	46.02 ± 16.75	52.18 ± 2.64	25.31 ± 5.74	11.03 ± .02	1.28 ± 0.18
Linolenic ($C_{18:3}$)	0.12 ± 0.09	5.63 ± 3.48	11.30 ± 6.09	--	--
Arachidic ($C_{20:0}$)	--	--	10.86 ± 3.29	--	--
Erucic ($C_{22:1}$)	--	--	11.35 ± 13.83	--	--

Table II. Percentage of saturated (SFA), monounsaturated (MUFA), polyunsaturated (PUFA) and total unsaturated (MUFA+ PUFA) fatty acid of each types of oil

Fatty acids %	Sunflower Oil (n=5) Mean ± SD	Soybean Oil (n=3) Mean ± SD	Mustard Oil (n=5) Mean ± SD	Palm Oil (n=3) Mean ± SD	Coconut Oil (n=6) Mean ± SD
SFA	8.51 ± 1.91	18.26 ± 0.67	15.94 ± 2.58	46.34 ± 0.40	92.92 ± 0.56
MUFA	45.5 ± 16.89	23.28 ± 1.99	49.57 ± 8.56	41.46 ± 0.56	5.84 ± 0.46
PUFA	46.10 ± 14.92	57.86 ± 1.20	36.62 ± 6.42	11.84 ± 0.92	1.28 ± 0.17
MUFA + PUFA	91.49 ± 1.91	81.14 ± 1.49	86.18 ± 3.07	53.30 ± 0.36	7.12 ± 0.51

Table III. Varieties of sunflower and mustard oil

	Sunflower oil variety(n=5)		Mustard oil variety(n=5)	
	i. High linoleic- low oleic		i. High erucic acid	
Sample No.	Linoleic acid (%)	Oleic acid (%)	Sample No.	Erucic acid (%)
S-1	61.24	27.76	S-1	14.73
S-2	66.55	22.78	S-5	34.12
	ii. Low linoleic-high oleic		ii. Low erucic acid	
	Linoleic acid (%)	Oleic acid (%)		Erucic acid (%)
S-3	29.45	63.55	S-2	4.76
S-4	34.08	59.04	S-3	2.25
S-5	38.80	53.83	S-4	0.91

It has been found in this study that sunflower, soybean and palm oils contained four to five FAs (Table I) each, whereas mustard oil and coconut oil contained seven and eight FAs respectively. Two to six different types of saturated FAs of chain length C_8 to C_{20} and two to four different types of unsaturated FAs of chain length C_{18} to C_{22} were found in all samples. Palmitic acid ($C_{16:0}$) and stearic acid ($C_{18:0}$) were common in all the saturates. Oleic acid ($C_{18:1}$) and linoleic acid ($C_{18:2}$) were common in the unsaturated FAs of all oils. Coconut oil, a nontraditional edible oil contained the highest number (six) and highest percentage (93 %) of SFA (92.92 + 0.56). Palm oil contained nearly 47 % SFA (46.34 ± 0.40) where palmitic ($C_{16:0}$) acid was predominant (41.78 ± 1.27). The major unsaturated FA of this oil was oleic acid (41.90 ± 1.20). Sunflower oil contained the lowest percentage of SFA (8.51 ± 1.91) followed by mustard oil (15.94 ± 2.56) and soybean oil (18.26 ± 0.67). Mustard oil contained two MUFAs, oleic ($C_{18:1}$) and erucic ($C_{22:1}$) acid. This oil contained the highest percentage of monounsaturated FAs (49.57 ± 8.56) followed by sunflower (45.5 ± 16.89), palm (41.46 ± 0.56) and soybean oil (23.28 ± 1.99), where oleic acid was predominant. Soybean oil was rich in PUFAs (57.86 ± 2.0) followed by sunflower (46.10 ± 14.92), mustard (36.62 ± 6.42) and palm oil (11.84 ±0.92).

Sunflower and soybean oil contained both the EFAs, linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) acid. The total percentage of essential fatty acids (linoleic and linolenic) in soybean oil is 57.81 ± 6.12 and that in sunflower oil is 46.14 ± 16.84 (Table. I). Our findings appeared identical with those of earlier published findings (Mowlah *et al.* 1990) in the context of major fatty acids of the respective oils with the exception of Mustard and Sunflower oil. In Mustard oil, we found two varieties in respect of erucic acid composition (=5 %, n=3 and 14-34 %, n=2). In

Sunflower oil also two types were found in consideration to percent composition of oleic (53-63 %, n=3 and 22-27 %, n=2) and linoleic acids (61-66 %, n=2 and 29-38 %, n=3) (Table III). This variation might be due to difference in the variety of sunflower and mustard seed.

Conclusion

In consideration of total percentage of unsaturated fatty acids (MUFA+PUFA), Sunflower oil appears superior. On the other hand in respect to total percentage of essential fatty acids (linoleic and linolenic) soybean oil is superior. But on overall consideration, sunflower oil with the highest percentage of mono and polyunsaturated fatty acids especially the high linoleic-low oleic variety appeared to be suitable for mass consumption to combat malnutrition. Proper attention should be given to identify this particular variety of sunflower seed and to promote enhanced production to make it available for general consumption.

Acknowledgement

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CHEMICAL & ENGINEERING NEWS

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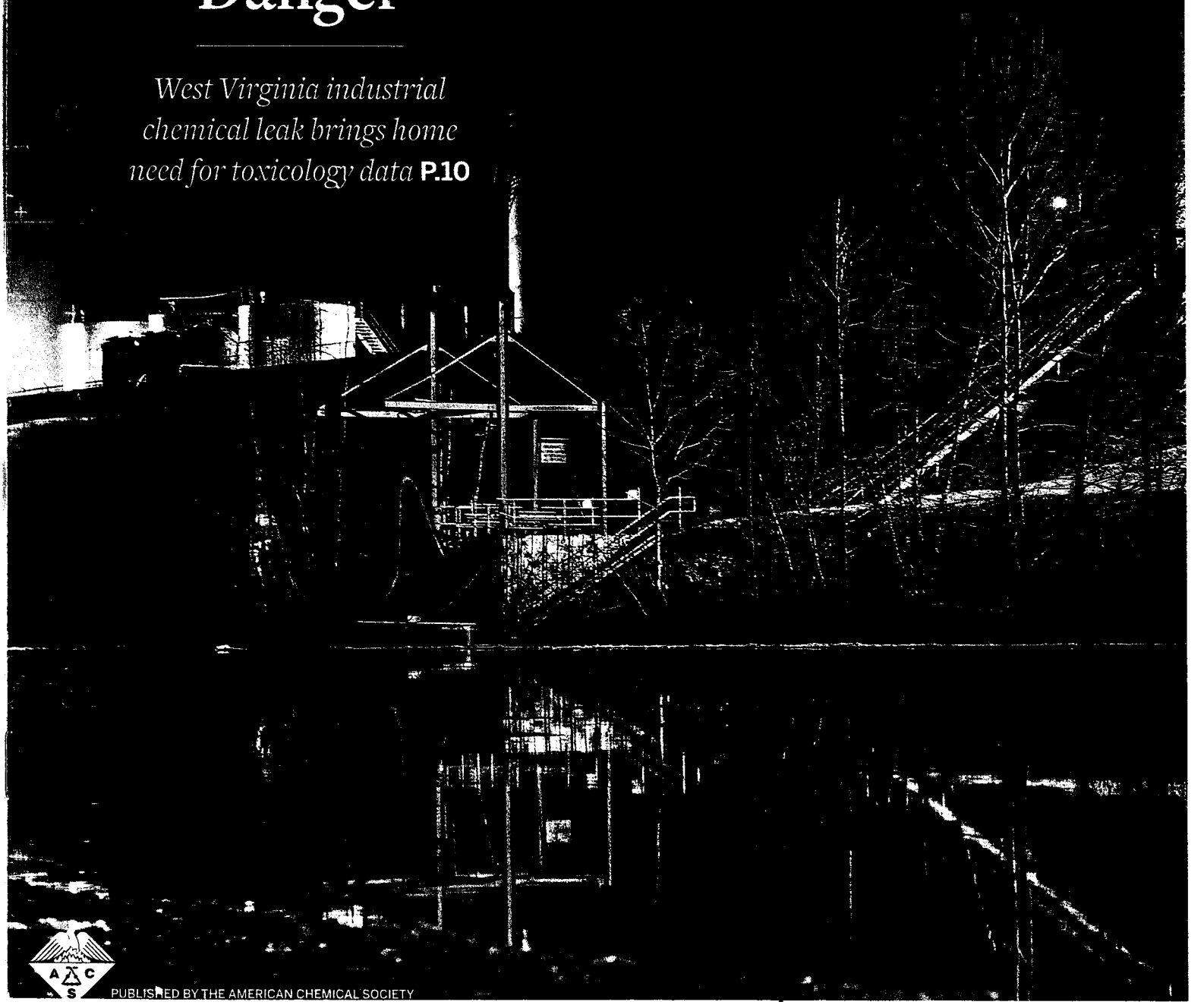

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OBSCURE CHEMICAL TAINTS WATER SUPPLY

Chemical contamination of West Virginia **DRINKING WATER** system raises scientific, policy shortcomings

ALEXANDER H. TULLO, C&EN NORTHEAST NEWS BUREAU; JYLLIAN KEMSLEY, C&EN WEST COAST NEWS BUREAU; CHERYL HOGUE & SUSAN R. MORRISSEY, C&EN WASHINGTON

WEST VIRGINIA GOV. EARL RAY TOMBLIN gave the 300,000 residents of Charleston unwanted and unexpected news on Jan. 9. Their water was tainted with an obscure chemical used in coal processing. He ordered them to stay away from their taps.

"I learned about the water contamination from watching the announcement on TV at about 6 PM," recalls Juliana Serafin, an assistant professor of chemistry at the University of Charleston. She was worried. She'd taken a shower that afternoon after her regular 4-mile run. Her daughter had drunk a huge cup of hot tea.

But other than a slight black-licorice odor in her laundry room, she says, "neither of us noticed anything unusual." This telltale smell, in fact, was reported by many residents earlier in the day and led to officials discovering the contamination.

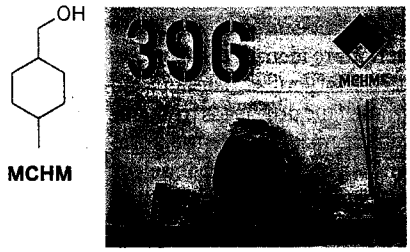
In any case, Serafin headed out to the grocery to buy bottled water.

"There was no regular water left, but I was lucky enough to get three 2-L bottles of club soda," she says. "We started eating off paper plates. And I successfully made coffee with club soda."

Another West Virginia resident, Mark Darcy, a manufacturing process chemist at

DRINKING WATER CRISIS UNFOLDS

Jan. 9 Leak Detected Chemicals leak from a storage tank into the Elk River, tainting the drinking water of 300,000 people in the Charleston, W.Va., area. Initial 4-methylcyclohexanemethanol (MCHM) volume estimate is 2,000 to 5,000 gal.



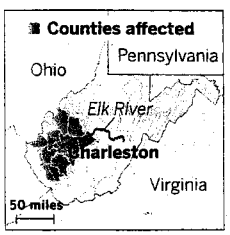
Left, tank 396 is the one that leaked MCHM. Below, people wait in line on Jan. 10 for bottled water.

8:15 AM Residents complain of black licorice odor → **10:30 AM** Freedom Industries employees discover leak → **11:15 AM** State officials find crude MCHM tank leaking at Freedom site → **6 PM** Governor announces water ban

Jan. 10 Sampling Begins Initial water testing shows 1.04 to 3.35 ppm MCHM at the West Virginia American Water intake on the Elk River and 1.02 to 1.56 ppm MCHM in treated drinking water. The Centers for Disease Control & Prevention says 1 ppm in drinking water is unlikely to be associated with adverse health effects.

Jan. 15 More Warnings Issued CDC and the West Virginia Bureau for Public Health say that pregnant women, "out of an abundance of caution," may wish to avoid drinking tap water until MCHM levels are not detectable.

Jan. 18 Most Restrictions of Water Use Lifted West Virginia American Water lifts water use restrictions for last of affected households, but suggestion for pregnant women to avoid drinking the water remains.



Jan. 11 Volume of Spill Revised Upward Spill estimate is revised to 7,500 gal.

Jan. 13 Household Water Restrictions Lifted West Virginia American Water instructs some households to begin flushing pipes and clears use of municipal water without restrictions.

On Jan. 13, water was tested as it was flushed in a restroom at the State Capitol in Charleston.

Jan. 16 Toxicity Data Disclosed Eastman Chemical publicly releases toxicology studies on crude and pure MCHM.

Jan. 17 Bankruptcy Declared Freedom Industries files for Chapter 11 bankruptcy.

a local chemical plant, found out about the water ban on his way home from work.

The first thing (b) did when he got home was try to find out the name of the chemical, he tells C&EN. It turned out to be crude 4-methylcyclohexanemethanol (MCHM). "That doesn't sound fantastically hazardous," (b) recalls thinking. But after pulling up the chemical's safety data sheet, "I figured I wouldn't want to drink it," he says.

State officials referred to the same document, but it contains little toxicity information, leaving them in the dark about the threat posed by the water contamination. This situation has since raised many questions with lawmakers and the public about the chemical as well as other substances later disclosed to be blended with it. The questions vary from what these chemicals are used for to why more toxicity information about them isn't available.

THE BAN ON USING TAP WATER for everything from drinking to washing lasted more than a week for some residents. As of C&EN press time, the federal Centers for Disease Control & Prevention (CDC) continued to say that "out of an abundance of caution," pregnant women living in the affected area might want to avoid drinking the tap water. At a House of Representatives hearing held on Feb. 10 in Charleston, federal lawmakers repeatedly quizzed state and local water and health officials about whether the water was safe to drink. But the state and local officials hesitated to say with certainty that it was. Meanwhile, some residents are sticking to bottled water.

The chemicals entered the water supply when a tank storing crude MCHM leaked into the Elk River. The tank, owned by Freedom Industries, is located about 1.5 miles upstream from the intake pipe for Charleston's water supply system.

It remains unclear when the leak started, but Freedom determined that some 10,000 gal of material had escaped from the storage tank.

On Jan. 17, Freedom filed for Chapter 11 bankruptcy. In its bankruptcy documents, Freedom hypothesizes that a water line break saturated the ground beneath the storage tank, which then froze, leading to the rupture of the tank. The state has ordered Freedom to dismantle all the chemical storage tanks and their associated piping and machinery at the site.

Freedom disclosed to the West Virginia Department of Environmental Protection in the wake of the spill that the tank contained by weight 88.5% crude MCHM, which is a blend containing 68 to 89% MCHM along with other chemicals; 7.3% Dowanol PPh, Dow Chemical's brand of propylene glycol phenol ether; and 4.2% water.

According to CDC, however, the component Freedom cites as Dowanol PPh is a blend of PPh and a high percentage of dipropylene glycol phenyl ether (diPPh). Because there have been more toxicity studies on PPh, CDC is using it as a proxy for the blend. The screening limit calculated for PPh should also work for diPPh, the agency says.

Eastman Chemical, which manufactured the crude MCHM that leaked from the tanks, won't provide many details regarding how it makes MCHM. However, published references suggest that it is a coproduct of the hydrogenation of the polyester raw material dimethyl terephthalate into cyclohexanedimethanol, which Eastman uses to make high-performance polyester copolymers. Eastman notes on the safety data sheet for crude MCHM that the mixture contains between 1 and 2% cyclohexanedimethanol. This small percentage of cyclohexanedimethanol suggests that the two chemicals are manufactured in tandem.

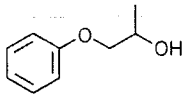
MCHM, A COPRODUCT of a little-known specialty chemical, is about as obscure as a petrochemical can be. Had it not been for the incident in West Virginia, it likely would have remained relatively unheard of, familiar primarily to technicians who operate froth floating lines at coal processing plants.

And that isn't a particularly large group. Only about 10% of coal runs through the froth flotation process, says (b) (7)(C) (b) (7)(C) a professor of chemical engineering at Michigan Technological University. The process is mostly used to purify residual material that is left after bituminous coal has been mechanically processed and gravel-sized chunks are separated out.

The leftover coal particles, most less than 1 mm in diameter, are wetted into a slurry, which is fed into a flotation cell. Air

ASSOCIATED PRESS (STORAGE TANK; PEOPLE IN LINE, STATE CAPITAL); COURTESY WEST VIRGINIA UNIVERSITY (WEST VIRGINIA WATER RESEARCH INSTITUTE

Jan. 21 Contents of Tank Clarified Freedom Industries reports that the leaking tank contained a second chemical, a proprietary mixture primarily composed of propylene glycol phenyl ether (PPh). CDC reports this mixture to contain dipropylene glycol phenyl ether (diPPh). The PPh mixture accounted for 7.3% of the tank's content by weight.



PPh


Researchers from West Virginia Water Research Institute collect soil and water samples from the Elk River.

Jan. 30 Federal Grants Issued To Study Spill The National Science Foundation announces Rapid Response Research grants to study the chemical spill.

Feb. 3 Toxicity Information for Other Chemicals Released CDC releases a summary report on toxicology studies of PPh and diPPh.

Feb. 5 CDC Gives All Clear CDC says water is safe for everyone, including pregnant women, to drink. MCHM smell persists in water.

Jan. 23 Testing of Additional Chemicals Begins Water testing begins for PPh and diPPh; testing includes stored water samples going back to Jan. 10. All samples fall below CDC's screening limit of 1.2 ppm.

Jan. 27 Volume of Spill Revised Upward Again Freedom Industries revises spill estimate to 10,000 gal of crude MCHM and PPh blend.

Jan. 31 Second MCHM Spill Reported Freedom Industries reports that another crude MCHM release occurred when cleanup crews severed an underground pipe; the spill was contained before it reached the river.

(b) (7)(C) RP1581 08/13/2014

bubbles in the flotation cell attach to the hydrophobic coal particles, lifting them to the surface. Hydrophilic impurities such as silica, pyrite, and clay—which would form ash if burned—remain in the liquid phase. The wastewater is either recycled or sent to tailing ponds.

Plant technicians use chemicals called frothers in the process, and crude MCHM and Dowanol PPh belong to this category. Frothers are surfactants that reduce the surface tension of water to stabilize and moderate the size of the air bubbles, according to (b) (7)(C) a professor of chemical engineering at Michigan Tech. Most frothers are aliphatic alcohols. A commonly used frother is methyl isobutyl carbinol. MCHM, (b) (7) ays, is "just another alcohol frother."

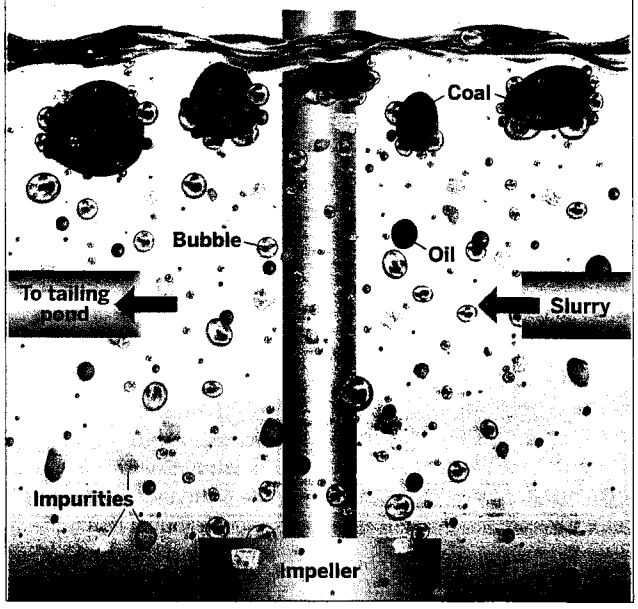
Froth flotation has been around for about 100 years, and methyl isobutyl carbinol has been used for about 70 years. MCHM is a relative newcomer to the process (b) (7) ays. In fact, water treatment specialist Nalco Chemical was granted a patent on using MCHM in froth flotation in 1990. The patent pitched MCHM as an environmentally friendly alternative to 2-ethyl hexanol.

Unlike MCHM, Dowanol PPh is used by many industries. Dow makes this chemical by reacting propylene oxide and phenol. It is primarily used as a solvent and coalescing agent in applications such as textiles, metal-working fluids, and coatings. It is also found in household and industrial cleaners. DiPPh is a by-product of Dow's process for making Dowanol PPh. Blends incorporating the chemical are used as fuels and in mining.

Despite its relatively recent application in coal processing, MCHM was in commercial production in 1976 when Congress passed the Toxic Substances Control Act (TSCA), the primary federal law governing industrial chemicals. Lawmakers "grandfathered" MCHM and some 62,000 other commercial chemicals then being made in the U.S. This exempted the compounds from the Environmental Protection Agency review required for new substances before they are sold on the market.

MCHM also was not among the 2,200 high-production-volume substances for which the chemical industry generated basic toxicity data under a voluntary program launched in 1998. The High Production Volume (HPV) Challenge Program, founded by EPA, the industry trade group American Chemistry Council, and the activist group Environmental Defense Fund, focused on chemicals produced in amounts of 1 million lb or more per year.

SKIMMING THE TOP Froth flotation tanks are used to purify residual coal material generated during coal processing. Bubbles introduced in the tank attach to hydrophobic coal particles, forcing them to the surface. Hydrophilic impurities such as silica, pyrite, and clay remain in the mixture. Plant operators add chemicals to the slurry to assist in the froth flotation process. One type of chemical is a collector, which coats the hydrophobic material to be separated so the air bubbles attach better. The coal industry largely uses No. 2 oil for this purpose. Another type of chemical is added to the slurry to reduce water surface tension in order to stabilize and moderate the size of the air bubbles. These chemicals include MCHM and PPh.



The program called for studies to be conducted to determine physical constants, environmental fate, and toxicity data. These studies have been estimated to cost thousands to millions of dollars for each substance, depending on which tests were conducted.

Although Eastman says it has manufactured between 5 million and 10 million lb of crude MCHM per year in the past decade, that wasn't the case when the HPV voluntary program began. EPA filings show that production of the substance didn't exceed 1 million lb per year until 2002, says (b) (7) (b) (7), a senior scientist and TSCA expert with the Environmental Defense Fund. (b) (7)(C) amp-up of MCHM output may be the result of a doubling of capacity for cyclohexanedimethanol by the company in 2006. (b) (7) xpanded capacity by another 25% in 2010.

Some information on the safety of MCHM does exist. After the leaked compound was identified, Eastman voluntarily released data it had from a suite of toxicity tests on both pure and crude MCHM. The company had conducted the tests in the late 1980s and '90s to evaluate short-term risks to its workers who might be exposed to the substance.

As the company pursues commercialization of products, it puts them through a regulatory and toxicity review, explains (b) (b) Eastman's vice president and assistant general counsel for global trade and compliance. As part of that review, the company evaluates the product's intended use, the geographic location where it will be sold, what regulatory requirements must be met, what is known about physical and toxicological hazards, and possible exposure based on how a substance will be used and in what volume.

The firm then decides what testing it will do. Eastman generally looks to have data from acute oral, dermal, eye, and mutagenicity studies, Jordan says.

From the results, "we determine what recommendations we want to make on employee personal protective equipment, inhalation risk, or other factors that we would want our employees and those of our customers to consider," he says. He was not involved in the MCHM decisions so could not comment on them specifically.

THE STUDIES Eastman conducted on pure and crude MCHM included both environmental and human exposure. The environmental studies involved exposure of two freshwater aquatic species, neonatal fleas and juvenile fathead minnows, as well as biodegradation. The tests followed routine protocols that are still standard today,

comments (b) (7)(C) professor of environmental toxicology at the University of California, Davis.

The minnow and water flea studies showed that crude MCHM is moderately toxic to those organisms (b) (7)(C) says. Crude MCHM proved to be not readily biodegradable in a solution of microbes extracted from wastewater treatment sludge but still showed more than 50% degradation after 28 days, Eastman's study report says.

"That's pretty good," (b) (7)(C) says. "Most microbial activity is in sediment, not in water, so to get that kind of degradation in water is not bad." He notes, however, that microbial degradation would likely be lower in a cold West Virginia river in January.

A MUTAGENICITY TEST, commonly called the Ames assay, was also done by Eastman to look at the ability of crude MCHM to cause genetic mutations in strains of bacteria engineered to be particularly susceptible to DNA damage. Crude MCHM did not induce mutations in tests the company conducted.

Additionally, Eastman performed a series of acute oral, dermal, and eye toxicology tests on rats, guinea pigs, and rabbits using both pure and crude MCHM. As with the environmental tests, the toxicology protocols are still routinely used, although toxicologists are trying to validate new methods to reduce the use of animals, says (b) (7)(C) a professor of toxicology at the University of Louisiana, Monroe. The longest exposure was a 28-day oral toxicity study of pure MCHM in rats. For an industrial chemical not intended to be a pesticide, (b) says that the set of tests would be fairly standard, with the addition of a 90-day oral study.

Overall, the mammalian studies showed that pure and crude MCHM are skin and eye irritants. "You don't want to shower in water with substantial concentrations of it," (b) (7) says, adding that "rashes are a definite possibility."

The irritant effects also may have caused gastrointestinal damage in rats dosed orally. Stumbling and weakness observed in rats after oral or high dermal dosing may have been an effect common to organic liquids. Pure and crude MCHM both showed low systemic toxicity.

The *Charleston Gazette* reported on Jan. 18 that some area residents were experiencing rashes, mild burns, and stomach upset after contamination of their water supply. A Jan. 18 news release from the governor's office suggested that some effects could be from sediment stirred up in pipes and hot-water tanks as water systems were flushed to remove MCHM so people could resume using the water.

As for longer-term or inhalation studies on MCHM, "we would not normally conduct chronic testing on a chemical of this nature, given the type of environment in which it was expected to be used," (b) (7)(C) says. The company also did not see it as posing a significant inhalation risk, he adds.

But (b) (7) of the Environmental Defense Fund says he is surprised that (b) (7) did not do toxicity testing using inhalation as a route of exposure. The company conducted tests for a chemical used in workplace settings, and workers would

most likely be exposed to crude MCHM on their skin or by inhaling it, Denison says.

"Conducting an inhalation exposure is more challenging than oral exposures," comments toxicologis[redacted] can be inhaled either as a vapor or an aerosol, she says. Inhalation studies require housing test animals in a special apparatus that may deliver airborne material to just the head and nose or to the whole body of individual animals. The atmosphere in the test chambers should be monitored to ensure consistent and known exposure, she adds.

Inhalation aside, Eastman's studies do not touch on a key toxicity end point of concern to officials managing the drinking water contamination: how crude MCHM might affect babies and fetuses, says Jennifer Sass of the Natural Resources Defense Council, an environmental group.

CDC used the results of the 28-day study of pure MCHM in rats to determine that a concentration of 1 ppm or less in drinking water was unlikely to produce adverse health effects. The 28-day study found that a daily dose of 100 mg pure MCHM/kg body weight produced no observed effects in rats.

To get from there to 1 ppm for drinking water, the agency combined 100 mg/kg with the weight of a small child, 10 kg (22 lb), and the estimated water intake of a child (1 L/day). Then it applied three 10-fold reduction factors to account for differences between rats and humans, people who might be more sensitive to MCHM, and the limited amount of data available. This reduction is fairly conservative, [redacted] says.

Initial water tests done in West Virginia on Jan. 10 showed 1.04 to 3.35 ppm MCHM at the water system intake on the Elk River, and 1.02 to 1.56 ppm in treated water. West Virginia American Water, the Charleston area utility, lifted the "do not use" order after flushing the distribution system and testing showed MCHM levels below 1 ppm. The utility instructed residents to flush their pipes for 25 minutes before using the water.

Toxicology information evaluated by CDC on another component of the spill, PPh, indicates that the chemical is less toxic than MCHM. The studies on PPh included a maternal toxicity study in rats that yielded a no-observed-adverse-effect limit of 40 mg PPh/kg body weight/day. CDC used that limit combined with the body weight and water consumption of a pregnant woman and the same uncertainty reduction factors to set a screening level of 1.2 ppm for PPh in drinking water.

Testing of stored water samples showed 0.01 ppm PPh in two samples from Jan. 10 and from Jan. 11; PPh was not detected in other water sampling through Feb. 9. The limit of detection was 1.2 ppm or 10 ppb, depending on the lab that did the analysis.

The lack of publicly available toxicology data on MCHM illustrates why TSCA is in dire need of modernization, critics say. Timely access to accurate toxicity information on commercial chemicals is essential to inform and protect the public, Natural Resources Defense Council's Sass says.

Eastman did provide full copies of its MCHM studies to government agencies and emergency responders within 24 hours of their requests, Jordan says. But under TSCA, there is no requirement for chemical makers to submit such data to EPA unless test results indicate that a substance might pose a substantial risk of injury to human health or the environment.

The Freedom site is regulated under the Clean Water Act, the statute that limits the amount of pollution that may enter waterways such as the Elk River. The facility had a permit—issued by West Virginia—that required the company to report on chemicals found in precipitation running off the site. It was also supposed to file a spill prevention plan with the state but apparently never did. The Center for Effective Government, a Washington, D.C., watchdog group, points out that MCHM is not on the list of chemicals that trigger notification to EPA when a substance is spilled into waterways.

Two other key federal environmental laws don't apply to MCHM.

The substance is not among the commercial chemicals covered under the Emergency Planning & Community Right-To-Know Act. This means Freedom wasn't required to inform local emergency responders that it was storing MCHM. Plus, the chemical isn't on the right-to-know law's Toxics Release Inventory. Companies must report environmental releases of chemicals on that list to EPA each year.

Likewise, MCHM isn't regulated under the law that requires monitoring of and sets limits on specific contaminants in municipal water, the Safe Drinking Water Act. That means West Virginia American Water isn't legally required to check for MCHM in the municipal water it provides.

FOR THE TIME BEING at least, testing for MCHM in the Charleston area's tap water continues. Traces continue to turn up, such as 0.013 to 0.018 ppm in a sample taken from an elementary school drinking fountain on Feb. 10. News reports say that some residents and employees at other local schools still report being able to smell the characteristic licorice smell of MCHM.

Louisville Water, which serves an area in Kentucky downstream from the leak on the Ohio River, conducted a study of MCHM using a taste and odor panel. The utility knew the crude MCHM was coming and had time to put in place measures that ensured the concentration of the chemical in drinking water was minimized. The utility found that some members of the panel could detect MCHM in concentrations as low as 1 ppb, says spokeswoman Kelley Dearing Smith.

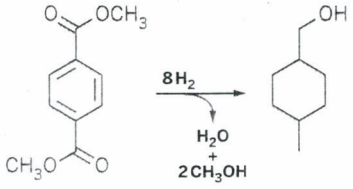
It is unclear how long traces of MCHM will remain in the tap water feeding into Charleston residents' homes. Gov. Tomblin stated on Feb. 5 that, despite the all clear the state issued to residents to use tap water, testing of the water supply for MCHM and PPh will continue.

State and federal officials' ability to give the public clear direction is hampered by a lack of data about how the leaked chemicals absorb onto water piping systems. To help fill in that knowledge gap, the National Science Foundation awarded $150,000

"The experience reminds you just how little data there are about so many of the chemicals that we use."

FORMATION

4-Methylcyclohexanemethanol (MCHM) is made via hydrogenation of the polyester raw material dimethyl terephthalate (DMT).



DMT MCHM

in Rapid Response Research grants to three groups in late January.

ONE OF THOSE GROUPS, led by (b) (7)(C), a professor of civil and environmental engineering at Virginia Tech, will first determine basic physical-chemical characteristics of MCHM that predict the chemical's fate and transport in the environment. This includes finding the chemical's solubility in water; its Henry's law constant, which determines how much will evaporate into air; and its octanol-water partition coefficient, which describes how well the substance partitions into living tissue or organic materials such as plastic pipes. The team also plans to evaluate sorption and uptake of MCHM by epoxy materials used to line water pipes and storage tanks.

(b) (7)(C) an environmental engineering professor at the University of South Alabama, is leading a second team that is studying the absorption of MCHM into different pipe materials and whether flushing can remediate contaminated plastic. He estimates that the contaminated water stagnated in pipes for four to seven days when the community was told not to use it. It's likely that pipes absorbed MCHM, possibly leading to long-term, low-level exposure as it leaches out.

Outside the NSF-funded work, (b) (b) group has sampled water in Charleston-area homes and plans to return to do follow-up sampling. (b) (7) s particularly interested to see how much MCHM turns up in three houses on a dead-end street, all drawing from the same water main but each piped with different materials. His field effort is as yet unfunded, and he is trying to raise money for the work through the crowdfunding website Experiment.com.

The third group funded by NSF will look at short- and long-term fate of MCHM in the water treatment and distribution system and in the river. The team is led by (b) (7)(C) a professor of civil and environmental engineering at West Virginia University. Part of the project involves water sampling to understand how well the flushing protocol worked, as well as examining in detail what happens to crude MCHM and PPh as they go through the drinking water treatment system. The ultimate goal of the work is to help develop better response plans for future disasters, Weidhaas says.

The results of such research can't come fast enough for those affected by the contamination.

"The experience reminds you just how little data there are about so many of the chemicals that we use," process chemist (b) notes.

Given that dearth of data, it's shocking that Freedom Industries paid so little attention to basic spill containment protocols, says (b) (7)(C) chief scientific adviser at Mid-Atlantic Technology, Research & Innovation Center, a nonprofit research company.

"Everywhere I've worked in the chemical industry safety is the primary concern," (b) (7) adds. "These guys weren't doing that at all. Fortunately, they've been shut down."

With additional reporting by A (b) (7)(C) *and* (b) (7)(C)

Freedom verifies two chemicals (Crude MCHM, PPH) in tank

Posted: Jan 22, 2014 4:49 PM MST

By (b) (7)(C) Content Manager - email

Freedom Industries told the West Virginia Department of Environmental Protection today that the tank that leaked materials into the Elk River from the company's Ettowah Terminal on Jan. 9 contained two chemicals – Crude MCHM and PPH.

Freedom was responding to an Order issued by the WVDEP this morning demanding that the company, by this afternoon, disclose all materials spilled during a release from Storage Tank 396 at its Elk River facility. The spill shut down the water supply for close to 300,000 West Virginia residents.

The WVDEP Order arose from Freedom's disclosure to the WVDEP on Jan. 21 that another chemical (PPH), in addition to Crude MCHM, was contained in the above-ground storage tank that leaked materials into the Elk River.

"PPH is added to the Crude MCHM to act as an 'extender' in that the Crude MCHM is available in limited, sporadic quantities," Freedom said in its response letter to the WVDEP. "At the time of the release on Jan. 9, the blend in Tank No. 396, after extensive calculation, was approximately 88.5 percent Crude MCHM, and 7.3 percent PPH by weight and 4.2 percent water by weight. Our records and internal investigations indicate that there were no other materials in Tank 396 at the time of the release."

Freedom's letter was signed by Freedom President (b) (7)(C)

Freedom told the WVDEP on Jan. 21 that the storage tank contained roughly 300 gallons of PPH that it adds to its Crude MCHM mixture. This material was not included in the initial information regarding the composition of the spilled materials. Failure to accurately report "the type or types and quantity or quantities of the material or materials therein" is a violation of state code.

Today's Order gave Freedom until 4 p.m. to provide any and all information fully describing the composition of the materials spilled into the Elk River on Jan. 9.

"Having this revelation so late in the game is completely unacceptable," said WVDEP Cabinet Secretary (b) (7)(C) said earlier today. "We have ordered Freedom to reveal any other information they have regarding the contents of the tank that leaked."

"Having to order them to provide such obvious information is indicative of the continued decline of their credibility," (b) (7) said.

Compliance with the terms and conditions of this Order did not in any way relieve Freedom Industries, Inc. of the obligation to comply with any applicable law, permit, other order, or any other requirement otherwise applicable. Violations of the terms and conditions of this Order would subject Freedom Industries, Inc. to additional enforcement action in accordance with the applicable law.

1

Web search and NLM Database Results for Propylene Glycol Phenyl Ether and Dipropylene Glycol Phenyl Ether

Version 1.1
Date: January 22, 2014

http://www.inchem.org/documents/sids/sids/770354.pdf
OECD. SIDS Initial Assessment Report For SIAM 18
Paris, France, 20-23 April 2004
1. Chemical Name: Propylene Glycol Phenyl Ether
2. CAS Number: 770-35-4 (major isomer ñ– Secondary Alcohol)
4169-04-4 (minor isomer ñ– Primary Alcohol)
41593-38-8 (commercial mixed isomer product)
3. Sponsor Country: United States
U.S. Environmental Protection Agency
(b) (7)(C) Director
Risk Assessment Division (7403M)
1200 Pennsylvania Ave., NW
Washington, DC 20460
Phone: 202-564-7641
4. Shared Partnership with: Industry Consortia
5. Roles/Responsibilities of the Partners:
Environmental and human health testing of propylene glycol ether
Name of industry sponsor/consortium
(b) (7)(C)
American Chemistry Council
1300 Wilson Boulevard
Arlington, VA 22209

http://www.ecetoc.org/index.php?mact=MCSoap,cntnt01,details,0&cntnt01by_category=5&cntnt01template=display_list_v2&cntnt01order_by=Reference%20Desc&cntnt01display_template=display_details_v2&cntnt01document_id=242&cntnt01returnid=89
European Center for Ecotoxicology and Toxicolohy of Chemicals (ECETOC)
TR 064: The Toxicology of Glycol Ethers and its Relevance to Man | August 1995

http://apps.echa.europa.eu/registered/data/dossiers/DISS-a212e0a8-c808-5392-e044-00144f67d031/DISS-a212e0a8-c808-5392-e044-00144f67d031_DISS-a212e0a8-c808-5392-e044-00144f67d031.html

European Chemicals Agency (ECHA)
Dossier Information on "1-phenoxypropan-2-ol." (Propylene Glycol Phenyl Ether)

- Home page
- General Information
- Classification and Labelling
- Manufacture, Use & Exposure
- PBT assessment
- Physical and chemical properties
- Environmental fate and pathways
- Ecotoxicological Information
- Toxicological information
- Guidance on safe use
- Reference substances

From Dow Web sites:

Dowanol PPH Technical Data Sheet:
http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_08ad/0901b803808ad688.pdf?filepath=oxysolvents/pdfs/noreg/110-00622.pdf&fromPage=GetDoc
The text is worth a look. Also, it states: "Dow encourages its customers and potential users to review their applications
from the standpoint of human health and environmental aspects. To help ensure that Dow products are not used in ways for which they are not intended or tested, Dow personnel will assist customers in dealing with environmental and product safety considerations. Dow literature, including Material Safety Data Sheets, should be consulted prior to the use."

and

Dowanol DiPPH Technical Data Sheet:
http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_08c3/0901b803808c3c4d.pdf?filepath=oxysolvents/pdfs/noreg/110%2001278.pdf&fromPage=GetDc
The text is worth a look. Also, it states: "Dow encourages its customers and potential users to review their applications
from the standpoint of human health and environmental aspects. To help ensure that Dow products are not used in ways for which they are not intended or tested, Dow personnel will assist customers in dealing with environmental and product safety considerations. Dow literature, including Material Safety Data Sheets, should be consulted prior to the use."

and

The online MSDS for Dowanol PPH is:
http://www.dow.com/webapps/msds/ShowPDF.aspx?id=090003e8803d20e7
MSDS is worth a close look, e.g., Sections 11 and 12 and the statement in Section 15 about Proposition 65 status.

and

The online MSDS for Dowanol DiPPH is:
http://www.dow.com/webapps/msds/ShowPDF.aspx?id=090003e88045c360
MSDS is worth a close look, e.g., Sections 11 and 12 and the statement in Section 15 about Proposition 65 status.

and

Dowanol Product Safety Summaries:

Product Safety Assessment. DOW™ Dipropylene Glycol Phenyl Ether Products
http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_02bd/0901b803802bdec3.pdf?filepath=productsafety/pdfs/noreg/233-00601.pdf&fromPage=GetDoc

Select a Topic:
Names
Product Overview
Manufacture of Product
Product Description
Product Uses
Exposure Potential
Health Information
Environmental Information
Physical Hazard Information
Regulatory Information
Additional Information
References

Product Safety Assessment for Propylene Glycol Phenyl Ether
http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_0119/0901b80380119ff3.pdf?filepath=productsafety/pdfs/noreg/233-00405.pdf&fromPage=GetDoc

Select a Topic:

Names
Product Overview
Manufacture of Product
Product Description
Product Uses
Exposure Potential
Health Information
Environmental Information
Physical Hazard Information
Regulatory Information
Additional Information
References

and

Uses of Dowanol Materials:
http://www.dow.com/products/market/personal-care-and-apparel/
DOWANOL™
Hydrophilic glycol ethers used in a broad range of applications, including coatings, cleaners and printing inks

DOWANOL™ DPnP Glycol Ether	Slow-evaporating glycol ether with a balance of hydrophilic and hydrophobic properties used in water- and solvent-based coatings
DOWANOL™ EPh Glycol Ether	Slow-evaporating glycol ether with high polymer solvency and excellent coalescing abilities for a wide range of applications
DOWANOL™ PMA Glycol Ether	Relatively fast-evaporating, moderately hydrophobic glycol ether ester with low viscosity for solvent-based systems
DOWANOL™ PGDA Glycol Ether	Clear, colorless, practically odorless glycol diester with a comparatively high boiling point used in coatings, inks, and agricultural products
DOWANOL™ PM Glycol Ether	Fast-evaporating, hydrophilic glycol ether with excellent active solvency and coupling abilities for coatings, inks and cleaners
DOWANOL™ PnB Glycol Ether	Fast-evaporating, hydrophobic glycol ether with high solvency and excellent coupling abilities
DOWANOL™ PnP Glycol Ether	Fast-evaporating glycol ether with a balance of hydrophilic and hydrophobic characteristics for cleaners and coatings
DOWANOL™ PPh Glycol Ether	Slow-evaporating, very hydrophobic glycol ether for coalescing and carrier solvent applications
DOWANOL™ TPM Glycol Ether	Slow-evaporating, hydrophilic glycol ether with active solvency and coupling power for cleaners, coatings and inks
DOWANOL™	Very slow evaporating, hydrophobic glycol ether with

TPnB Glycol Ether	surface tension-lowering ability used in coatings, cleaners and inks
DOWANOL™ DPM Glycol Ether	Hydrophilic glycol ether with a moderate evaporation rate and excellent coupling abilities for use in a wide range of applications
DOWANOL™ DPMA Glycol Ether	Hydrophilic glycol ether ester with a moderate evaporation rate and tailing solvent activities for coatings and printing inks
DOWANOL™ DPnB Glycol Ether	Slow-evaporating, hydrophobic glycol ether with surface tension-lowering abilities and coalescing properties for coatings and cleaners
DOWANOL™ DPM	Increase the effectiveness of household and institutional cleaners
DOWANOL™ TPM-H GE	DOWANOL TPM glycol ether is an ideal choice when high polymer solvency and extended system residence time are required. It can maintain rheological properties over time in products such as stamp pads and ball point pen inks.

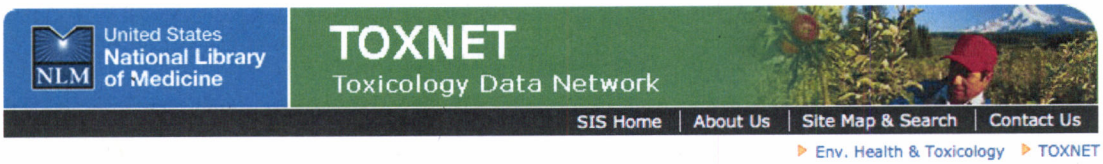
and

Dowanol PPH Uses and Other Dowanol PPH Information
http://www.dow.com/products/market/personal-care-and-apparel/product-line/dowanol/product/dowanol-pph-glycol-ether/

From National Library of Medicine Databases:

TOXNET, including HSDB

Search via http://toxnet.nlm.nih.gov/



TOXLINE Hits:

1 Propylene glycol phenyl ether
Anonymous
SIDS. Screening Information Data Set for High Production Volume Chemicals. (2006) 109 p [RISKLINE]

2 INITIAL SUBMISSION: ETHYLENE GLYCOL PHENYL ETHER & PROPYLENE GLYCOL PHENYL ETHER: COMPARATIVE 2-WEEK DERMAL TOXICITY STUDY IN RABBITS (FINAL REPORT) W COVER LETTER DATED 051492
EPA/OTS; Doc #88-920003157 [TSCATS]

3 SUMMARY OF RESULTS FROM A ACUTE DERMAL TOXICITY STUDY IN RABBITS WITH EPA ACKNOWLEGEMENT LETTER
EPA/OTS; Doc #FYI-OTS-0786-0503 [TSCATS]

4 AMBIENT AIR MONITORING
EPA/OTS; Doc #86-870002029 [TSCATS]

5 2-Phenoxy-1-propanol
BIBRA working group
(1992) 3p [RISKLINE]

6 PRESERVATION OF COSMETICS AND TOILETRIES
HILL G
ROSSMOORE, H. W. (ED.). HANDBOOK OF BIOCIDE AND PRESERVATIVE USE. XIV+424P. BLACKIE ACADEMIC AND PROFESSIONAL: GLASGOW, SCOTLAND, UK; CHAPMAN AND HALL, INC.: NEW YORK, NEW YORK, USA. ISBN 0-7514-0212-5.; 0 (0). 1995. 349-415. [BIOSIS]

ChemIDplus hit (one was not for this substance):

Propylene glycol phenol ether
RN: 41593-38-8

Basic Information

Full Record

Names & Synonyms

Formulas

Registry Numbers

For more information about this substance, you may select from the links below.

File Locator

PubChem — PubChem

PubMed — Biomedical Citations From PubMed

TOXLINE — NLM TOXLINE on TOXNET

Internet Locator

EPA SRS — EPA Substance Registry System

USA.gov — USA.gov Search Engine

Superlist Locator

CGB — DOT Coast Guard Bulk Haz. Mat.

Search Navigation

Main Query Page

Search Results Page

Advanced ChemIDplus Search

Results Name
Propylene glycol phenol ether

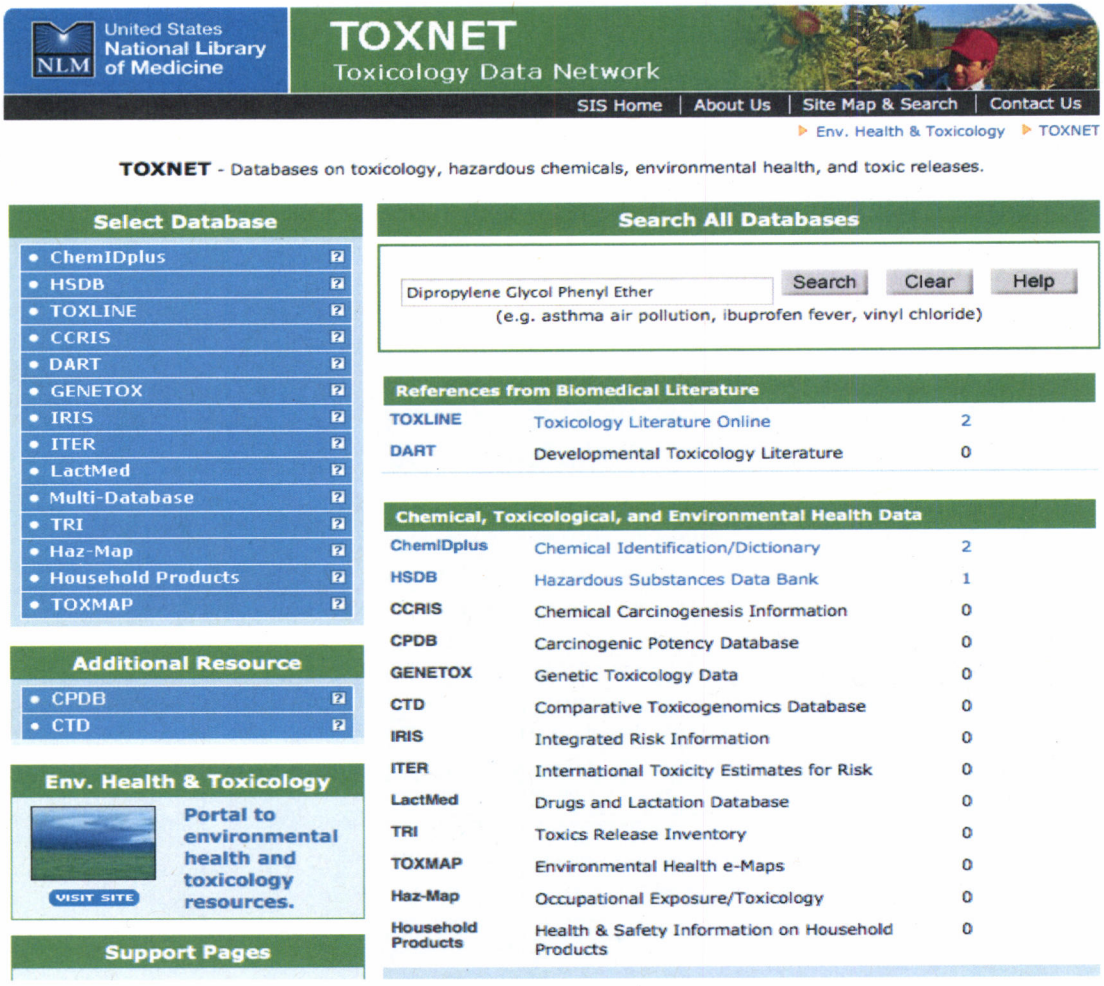
Synonyms
1(or 2)-Phenoxypropanol

AI3-09177
Dowanol PPh
Phenoxypropanol
Propylene glycol monophenyl ether
Propylene glycol phenol ether
Propylene glycol phenyl
Solvenon PP

Systematic Name

Propanol, 1(or 2)-phenoxy-
Propanol, phenoxy-

and



Note: The ChemIDplus two hits and the HSDB one hit are NOT for this substance.

TOXLINE Hits:

Items **1** through **2** of **2**
*records are sorted in relevancy ranked order and **not by date**.*
*Click on **Sort** to change the order of the retrieved records.*

Select Record	record
1	The toxicology of glycol ethers and its relevance to man ECETOC working group ECETOC Technical Report Vol:64 (1995) 348 p [RISKLINE]
2	A field study on clinical signs and symptoms in cleaners at floor polish removal and application in a Swedish hospital. (b) (7)(C) [redacted] Int Arch Occup Environ Health. 2010, Jun; 83(5):585-91. [International archives of occupational and environmental health] [PubMed] PubMed Citation

CAS# searches:

CAS 51730-94-0 Nothing

CAS 770-35-4 http://chem.sis.nlm.nih.gov/chemidplus/rn/770-35-4 plus eleven Toxlne publications

CAS# 28212-40-4 Five Toxline publications and one DART publication.

and

Specific search of Household Products Database (in TOXNET, but needs a click from TOXNET results to see what it has)

Household Products Database

http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=2531&query=Propylene+glycol&searchas=TblChemicals

Chemical Information
Chemical Name: Propylene glycol phenyl ether
CAS Registry Number: 000770-35-4
Synonyms: Propylene phenoxetol; 2-Propanol, 1-phenoxy-

Information from other National Library of Medicine databases
Health Studies: ***No information available in HSDB at this time***
Toxicity Information:

Search TOXNET
Chemical Information: Search ChemIDplus

Products that contain this ingredient
Brand Category Form Percent
Sikagard High Gloss Sealer Home maintenance liquid 0.5-1.5
Quikrete Acrylic Concrete Cure and Seal No. 8800 Home maintenance liquid
Quikrete Concrete & Masonry High Gloss Sealer No. 8800-06-04/29/2010 Home maintenance liquid

and

http://householdproducts.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=3700&query=Dipropylene+glycol&searchas=TblChemicals

Chemical Information
Chemical Name: Dipropylene glycol phenyl ether
CAS Registry Number: 051730-94-0
Synonyms: (Methyl-2-phenoxyethoxy)propanol; Propanol, (methyl-2-phenoxyethoxy)-; DiPPh; Propanol, (methyl-2-phenoxyethoxy); Propanol, 1-(methyl-2-phenoxyethoxy)-; Propanol, 2-(methyl-2-phenoxyethoxy)-

Information from other National Library of Medicine databases
Health Studies: ***No information available in HSDB at this time***
Toxicity Information:
Search TOXNET
Chemical Information: Search ChemIDplus

Products that contain this ingredient
Brand Category Form Percent
Resolve Bright and Resolve Carpet Cleaner Dual Power Laundry Stain Remover, Pump Spray Inside the Home liquid (Chamber A)
Lysol Antibacterial Kitchen Cleaner, Pump Spray Inside the Home pump spray
Resolve Triple Action Carpet Stain Remover, Pump Spray-(Canadian Market) Inside the Home pump spray
Resolve Pet Stains Carpet Stain Remover, Pump Spray-(Canadian Market) Pet Care liquid
Resolve Pet Oxi Advanced Carpet Stain Remover, Pump Spray Pet Care liquid

and

Specific search of Haz-Map (in TOXNET, but needs a click from TOXNET results to see what it has)

http://hazmap.nlm.nih.gov/search?search_query=Propylene+Glycol+Phenyl+Ether+

1. Summary Report of Short-term Screening Level Calculation and ...
   emergency.cdc.gov/.../DiPPH-PPH-calculation...
   - Cached
     United States Centers for...
     Loading...
     Jan 22, 2014 - Studies for **Dipropylene Glycol Phenyl Ether** (DiPPH) and Propylene Glycol Phenyl Ether (PPH). Background: On January 9, 2014 the release **...**

Summary Report of Short-term Screening Level Calculation and Analysis of Available Animal Studies for Dipropylene Glycol Phenyl Ether (DiPPH) and Propylene Glycol Phenyl Ether (PPH)

Background:

On January 9, 2014 the release of methylcyclohexane methanol (MCHM) material from a storage tank into the Elk River resulted in contamination of the water system in the Charleston, West Virginia area. Based on information provided by the manufacturer on January 22, 2014 the composition of the released material was reported to be 88.5 % MCHM, 7.3 % PPH Stripped basic and 4.2 % water. The material PPH Stripped is reported to be primarily composed of dipropylene glycol phenyl ether (DiPPH) and propylene glycol phenyl ether (PPH). At this time, West Virgina is sampling the water system for MCHM and PPH Stripped. CDC/ATSDR has reviewed summaries of toxicological studies conducted on PPH and DiPPH provided by the manufacturer. CDC/ATSDR will review any additional toxicological data when it becomes available.

Summary of Available Toxicological Information on Dipropylene Glycol Phenyl Ether (DiPPH):

Based on the most recent Material Safety Data Sheet (MSDS) provided by the manufacturer, the highest percentage compound in PPH Stripped is dipropylene glycol phenyl ether (DiPPH), reported to represent up to 85% of the total PPH Stripped. There is no No Observed Adverse Effect Level (NOAEL) available for this compound. The only toxicological information available at this time indicates that that the acute toxicity by ingestion in rats for the PPH Stripped is an LD50 of >2000 mg/kg. The chemical structure of DiPPH, the LD 50 information and the application of an additional uncertainty factor suggest that the screening values calculated below for PPH would be protective for both components of the mixture.

Summary of Available Toxicological Information on Propylene Glycol Phenyl Ether (PPH):

- In a 90-day drinking water study in rats concentrations of 500, 2000 and 6000 ppm have been used. At 500 ppm no substance related effects have been observed, and at 2000 ppm the only effects observed were decreased body weight (<10%) and discoloration of urine. Therefore, the 2000 ppm (146 mg/kg bw/d) dose level is considered to be the NOAEL. In another study, varying amounts PPH was administered to rats via drinking water for a 26 week period. NOAEL was 1000 ppm (113 mg/kg-day). The Lowest Observed Adverse Effect Level (LOAEL) was 5000 ppm (478 mg/kg-day).
- In a developmental toxicity study, varying amounts of PPH were administered to pregnant rabbits over a 4-week period by the oral route of exposure. The NOAEL for fetal toxicity based on skeletal variations was 180 mg/kg-day. The LOAEL for fetal toxicity was 540 mg/kg-day.
- In a teratology study in rats a NOAEL for maternal toxicity was 40 mg/kg-day. **(CDC used this study to establish a short term screening level for PPH in the Elk River because it is the most protective NOAEL dose provided).**
- The NOAEL for development toxicity observed in rats was 160 mg/kg-day.

Screening Level Calculation for Propylene Glycol Phenyl Ether (PPH):

CDC/ATSDR used the following methodology[1] to establish a short term screening level of 1.2 ppm PPH in the water system:

The most sensitive toxicological result is the NOAEL for maternal toxicity at 40 mg/kg-day. We assumed 75 kg body weight for a pregnant woman during the first trimester and consumption of 2.5 L water/day

$$DW\ Advisory \leq \frac{NOAEL \times BW}{UF \times Intake}$$

Where:

- DW Advisory = Drinking Water Advisory
- NOAEL = No Observed Adverse Effect Level in the experimental species
- BW = Body weight of a pregnant mother (EPA Exposure Factor Handbook, 2011 Edition)
- UF = Uncertainty factors that address differences between animals and humans (10X), address differences accounting for sensitive humans (10x), and account for weaknesses in the toxicological database (10X).
- Intake = The estimated intake from drinking water of a pregnant mother in liters

Calculating using 75 kg BW and 2.5 L daily consumption rate:

NOAEL (mg/kg/d)	BW (kg)	UF (unitless)	Intake (L/day)	DW Advisory (mg/L or ppm)
40	75	1000	2.5	1.2 ppm

Note: Very limited specific toxicological information is available for DiPPH at this time. However the LD50 of > 2000 mg/kg and chemical structure suggest similar or lower toxicity, and the screening value calculated for PPH would also be protective for DiPPH.

Other Components

The MSDS lists additional minor constituents of 2-Hydroxy-alpha-methyl-benzeneethanol, 2-Hydroxy-beta-methyl-benzeneethanol and polypropylene glycol phenyl ether. Currently no toxicological information is available for these constituents.

Additional Information

The information used to determine the short-term screening value for DiPPH and PPH is based on unpublished proprietary information provided to CDC/ATSDR in summary form. CDC/ATSDR continues to work closely with federal and state partners to acquire and review additional toxicological data as it becomes available and will update this guidance if additional relevant information is received.

The available toxicological information has been reviewed by our federal partners including the National Institute of Environmental Health Sciences and National Toxicology Program, the National Library of Medicine, the Environmental Protection Agency, and they have concurred with the approach and methodology used in developing this screening level.

References:

Dow Chemical Company MSDS for PPH Basic, Nov 15, 2011.

Dow Chemical Company, Chemical Safety Report Substance Name 1-phenoxypropan-2-ol, July 9, 2010.

EPA Exposure Factor Handbook, 2011 Edition: http://www.epa.gov/ncea/efh/report.html

Freedom Industries MSDS for PPH, stripped, October 15, 2013.

OECD SIDS Initial Assessment Report, Propylene Glycol Phenyl Ether, SIAM 18, April 20-23, 2004 www.inchem.org/documents/sids/sids/770354.pdf

(b) (7)(C) Health advisory values for drinking water contaminants and the methodology for determining acute exposure values. *Sci Tot Env.* 288 (2002) 43-49.

Our Water WV

Responding to the Freedom Industries chemical spill

What else is in crude MCHM?

The National Library of Medicine (NLM) just introduced a new record to its Hazardous Substances Data Bank (HSDB <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>) for the chemical 4-Methylcyclohexanemethanol <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+4-Methylcyclohexanemethanol> (or MCHM), which has a Chemical Abstracts Service registry number (CASRN) of 34885-03-5. CASRNs are important because they help distinguish between closely related chemicals (or any chemicals, really). In this instance, the CDC based its estimation <http://www.wvgazette.com/News/201401170026> of a safe level in our water supply using studies that focused only on the pure version of MCHM–when in fact crude MCHM was leaked.

And as the Material Safety Data Sheet <http://mediad.publicbroadcasting.net/p/wvpn/files/201401/MSDS-MCHM_I140109214955.pdf> on crude MCHM shows, several other chemicals are involved. And with the CASRNs, we can find information about the other chemicals in crude MCHM. The main ingredient is, of course, **4-Methylcyclohexanemethanol**, making up 68% to 89% of crude MCHM.

Coming in second is **4-Methoxymethylcyclohexylmethanol** (CASRN: 98955-27-2), which represents between 4% and 22% of the mix. Unfortunately, there seems to be even less information about this chemical than its big sister, 4-Methylcyclohexanemethanol. A Google search of the chemical name along with its CASRN produced just two pages of results, including mention of it in media reports on the leak and links to companies from which you might purchase the substance.

A search of the HSDB indicates that 4-Methoxymethylcyclohexylmethanol is a "related substance" to MCHM, but includes no additional information. A site associated with the NLM called ChemIDplus <http://chem.sis.nlm.nih.gov/chemidplus/rn/98955-27-2> indicates that it has a Flag P in the Toxic Substances Control Act (TSCA) Chemical Substances Inventory. According to the EPA <http://www.epa.gov/oppt/newchems/pubs/tscainventorydatahelp.htm>, this means that the chemical is new and has a "commenced premanufacture notice."

Water, representing 4% to 10% of crude MCHM, is our old–if now beleaguered–friend.

Methyl 4-methylcyclohexanecarboxylate (CASRN: 51181-40-9) is likewise difficult to get to know, with the HSDB classifying it as a "related substance" to MCHM. There's somewhat more information here <http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=170993>, but no safety or environmental information. This chemical constitutes 5% of crude MCHM.

Dimethyl hexahydroterephthalate <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+DIMETHYL+HEXAHYDROTEREPHTHALATE> (CASRN: 94-60-0)–also called DMCD–makes up 1% of crude MCHM. No safety or environmental analyses are reported, and guidance on disposal is as follows:

> "At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices."

More information is available from its manufacturer, Eastman <http://www.eastman.com/Products/Pages/ProductHome.aspx?Product=71001796&list=Chemicals>, including this Safety Data Sheet <http://ws.eastman.com/ProductCatalogApps/PageControllers/MSDS_PC.aspx?Product=71001796>. As with MCHM, no data are available on most toxicological or ecological categories, with several exceptions. It appears as though studies have been conducted on the oral toxicity of the chemical in rats, dermal toxicity in guinea pigs, inhalation by rats, and skin corrosion in guinea pigs, as well as ecological studies with fish, aquatic invertebrates, and aquatic plants. No studies of carcinogenicity are reported.

Methanol is well known, but you can learn more from the NLM <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+METHANOL> or Medscape <http://emedicine.medscape.com/article/1174890-overview>.

Lastly, **1,4-Cyclohexanedimethanol <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+1,4-CYCLOHEXANEDIMETHANOL>** (CASRN: 105-08-8) makes up 1-2% of crude MCHM. According the NLM, no safety research has been conducted on this substance (although the site does summarize several studies on its metabolization by rats). A disclaimer preceding generic emergency treatment information reads:

> "A SPECIFIC REVIEW on the clinical effects and treatment of individuals exposed to this agent HAS NOT YET BEEN PREPARED. The following pertains to the GENERAL EVALUATION and TREATMENT of individuals exposed to potentially toxic chemicals."

Although some of the components of crude MCHM are present in very small percentages, it's nonetheless revealing to learn how little is known about most of them. And it begs the question of why our leaders have done so little to protect our safety, our environment, and our ability to do business in the face of so many unknowns.

A doctor we know points out that public health authorities in many countries operate on the precautionary principle that chemicals should be regulated until they are proven safe; West Virginian lives and livelihoods are certainly worth that consideration as well.

Posted by Caitlin on Posted in Emergency Information <http://ourwaterwv.org/category/emergency-information/>, Freedom Industries <http://ourwaterwv.org/category/freedom-industries/>

1 Comment

1. *Caitlin* says:
   January 26, 2014 at 9:40 PM <http://ourwaterwv.org/what-else-is-in-crude-mchm/#comment-70>
   You can look up the names of the individual chemicals on Google and on the hazardous chemicals database that's linked to in the post. But I haven't found a single site that includes information about all the chemicals in crude MCHM.

   Reply </what-else-is-in-crude-mchm/?replytocom=70#respond>